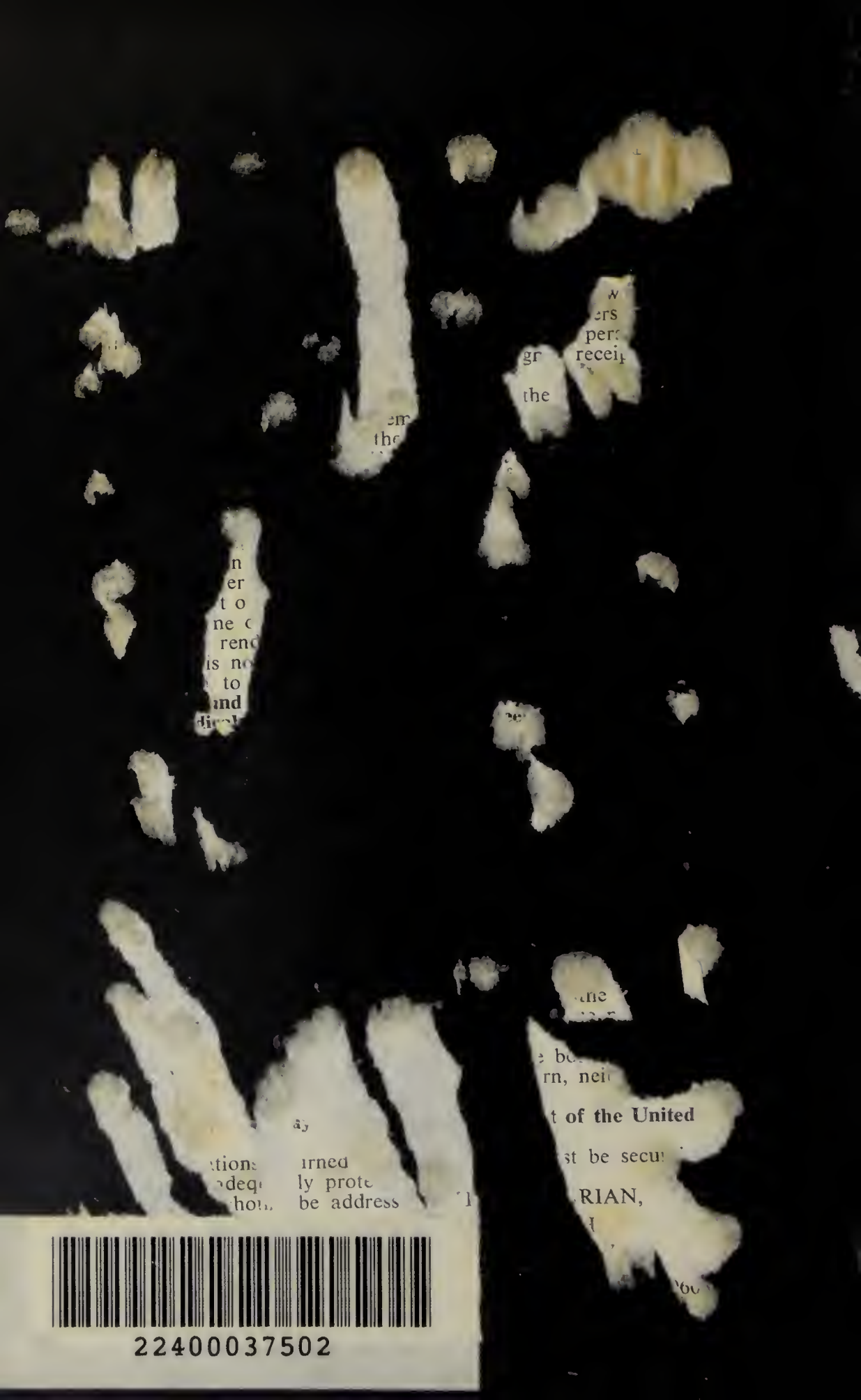
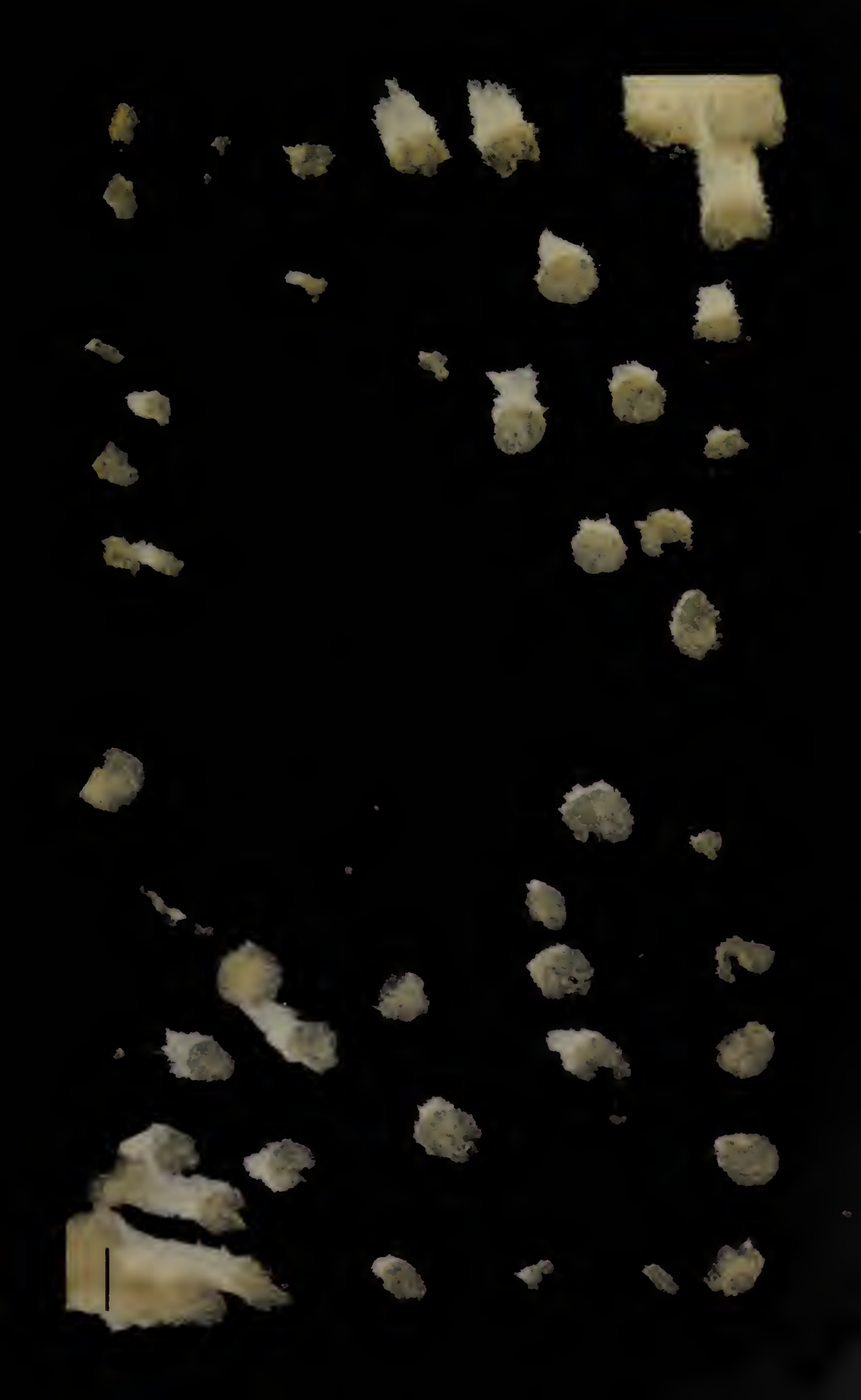




Willcocks. 81.

MILITARY SANITATION

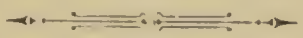
FOR

SOLDIERS SERVING IN HOT CLIMATES

BY

Major ROBERT J. BLACKHAM, D.P.H. (LOND.),
R.A.M.C.

Of the Middle Temple, Barrister-at-Law;
Honorary Associate of the Order of St. John;
Divisional Sanitary Officer, First Division, Indian Army;
Fellow of the Society of Medical Officers of Health, and of the Royal Institute of Public Health; Member of the Royal Sanitary Institute.



BOMBAY:
THACKER & Co., LTD.

LONDON:
W. THACKER & Co., 2 CREED LANE, E.C.

1909

MILITARY SANITATION

Dedicated

BY PERMISSION

TO

LIEUTENANT-GENERAL SIR JAMES WILLCOCKS,

K.C.M.G., C.B., D.S.O,

General Officer Commanding

The First (Peshawar) Division of the Indian Army,

whose deep interest in every detail affecting the well-being of the Soldier is familiar to all classes throughout the British Empire.

CONTENTS.

PREFACE.

In a celebrated speech delivered at Manchester so far back as 1872, Lord Beaconsfield substituted the words *sanitas sanitatum omnia sanitas* for the famous dictum of King Solomon, and declared that to his mind the great social question which should engage the attention of statesmen is the health of the people, because it refers to all those subjects which can advance the health and comfort of man.

If the health of the nation should engage the first attention of statesmen, surely the health of the troops under their command has an absolutely supreme claim on the attention of officers and non-commissioned officers.

The following pages originated as a senior course of lectures delivered to officers and non-commissioned officers of H. M. Troops at Devonport whilst the author was acting as Specialist Sanitary Officer, Western Area, Southern Command.

They have been carefully revised, adapted to meet Indian requirements, and delivered to British officers and non-commissioned officers at Peshawar.

At the suggestion of many friends in staff and regimental employment they are now offered to a wider audience in the hope that they may not only be of use to officers presenting themselves for examination for promotion in subject (*j*) but also of real utility to the readers and their men when that desideratum of the soldier's life arrives, namely, active service.

The author has to thank Colonel C. H. Beatson, C.B., Principal Medical Officer of the 1st Division, for much help and encouragement in preparing these pages for the press and for many valuable hints and suggestions. He acknowledges his indebtedness to the various authors named overleaf and suggests that many of the volumes referred to might well find a place in regimental and garrison libraries in India.

REFERENCES.

Aldridge, Lt.-Col. A. R. ... Prevention of Disease in the Army (Calcutta, 1907).

Caldwell, Lt.-Col. R. .... Prevention of Disease in Armies and Military Hygiene (London, 1905).

Elkington, Lt.-Col. H. P G ... Notes on Military Sanitation (London).

Firth, Lt.-Col. R. ... ... Theory and Practice of Hygiene and Military Hygiene (London, 1908).

Hutchison, Robert .... Food (London, 1907)

Lelean, Captain ... ... Military Hygiene (Meerut, 1908).

McCabe, F. F. .... War with Disease (London, 1907).

Munson, Captain E. .... Military Hygiene (London)

Newman, George .. ... The Health of the State (London, 1906)

Williams, Arnold .... Domestic Hygiene (London, 1898).

Williams, Mattieu ... . Philosophy of Clothing (London).

Wilson, E M. .. .. Healthy Homes (London).

The Journal of the Royal Army Medical Corps and various official publications.

The author expresses his gratitude to the Editors of *The British Medical Journal* and *Journal of the R.A.M.C.*, to Dr. Robert Hutchison, and to Colonel Firth and his publishers, Messrs. J. and A. Churchill, for kind permission to reproduce various drawings and illustrations.

CHAPTER I.

The Communicable Diseases of Soldiers.

"*When man learnt how to protect himself from wild beasts he made the first step in civilization. To-day man is learning how to defend himself from microbes—it is a step of equal importance. A day will come when in Berlin, in London, in Paris man will not die of diphtheria, of typhoid, of scarlet fever, of cholera, of tuberculosis any more than he dies in these cities to-day from the venom of snakes or the tooth of wolves.*"—*Frankland's Pasteur, 129.*

"Health is indispensable in war and cannot be replaced by anything."

This is not the dictum of a medical enthusiastic or a sanitary expert but a maxim of the greatest captain the world has ever seen.

Nor is the victor of Austerlitz and Lodi alone in this view, for we find his contemporary and foe, Lord Nelson, writing that "the great thing in all military service is health, and you will agree with me that it is easier for an officer to keep men healthy than for a physician to cure them" (March 11th, 1804.) Nor need we go back a century or so for such expressions of opinion from leaders of men, as we find one of our greatest living soldiers, Lord Wolseley, writing as follows :—

"No man can be a truly great general who is ignorant of the great laws upon which sanitary science is based. One of the greatest leaders of men was Moses, and it is curious as well as instructive to read in Holy Writ the laws he enacted for the sanitation of his great camps. If we do not take care of the health of our men we shall never be able to bring them 'smiling to the post,' and unless they go into battle laughing with health and the good spirits which follow on good digestion, we must not expect great things from them."

It is not, however, merely the officers' duty to take care of their men's health, it is their duty to take care of their own and to see that their men look after themselves. In this relation a general officer with wide Indian experience, Sir R. C. Hart, V.C., very truly says: "Even an elementary knowledge of sanitation saves many lives and much suffering. People contract sickness frequently with fatal results as a consequence of the ignorance and carelessness of their neighbours, it is therefore the duty of every individual in the community to pay strict attention to the simple rules of health."

The King's Regulations now require that all officers must pass in hygiene before promotion to the rank of captain but as yet no regulations exist making sanitation a subject for the examinations of non-commissioned officers. As the spur of an examination is often necessary to produce our best mental paces it is hoped that non-commissioned readers will present themselves for the certificate in Military Sanitation recently instituted by the St. John Ambulance Association.

It may help the student to point out that hygiene or sanitation, whichever you like to call it, has been defined as a science which has for its object to make growth more perfect, decay less rapid, life more vigorous and death more remote.

At one time it was thought that the prevention of disease was merely a matter for the doctors and did not concern either layman or fighting men, but this view is surely not tenable as the preservation of health is a personal and not a purely medical matter.

It is the duty of the cleric to preach the Gospel but the salvation of the individual must depend on his own individual exertions.

Similarly, it is the duty of the military surgeon to preach the gospel of hygiene, but it is the business of the fighting soldier to carry his precepts into practice if he wishes to survive a tour of service abroad and return to his friends in

Britain when, in the words of the barrackroom, he joins the happy few who year by year become "time-expired."

The point we wish to emphasize is that when one embarks on a tour of service in any foreign country one sets out from the beginning to fight a real enemy.

The valor of the British soldier in the presence of a visible foe is beyond dispute or discussion, and you have learnt how to meet all tangible foes according to the latest methods of military science, but in India, year in, year out, you have to combat invisible foes who have declared war on all humanity.

The foes we refer to are the microbes of so called tropical disease.

We want you in return to declare war against them, and we wish to show you that these foes are by no means despicable.

They are far more dangerous than the bullets or bayonets of a hostile army.

As proof of this we would invite your attention to the table underneath which shows you that (omitting all decimal points) in the last big campaign on the Indian frontier there were 25 admissions for disease for one from injuries, and 14 deaths to the microbe for each man credited to the Afridis.

Ratios per 1,000 of strength.

WAR.	ADMISSIONS.			DEATHS.		
	For disease	For wounds or injuries.	Total	From disease.	From wounds.	Total.
Tirah 1897-98	573	25	598	28	2	30
Nile 1898	1,101	56	1,157	36	15	51
China 1900-01	1,051	10	1,061	22	2	24
South Africa 1899-1901	746	34	780	69	42	111

Again we would remind the reader of a famous battle, with which all are, doubtless, familiar, viz. the battle of Valmy.

We are not concerned with military details, and would only ask him to remember that on the one side were the finest soldiers in Europe under the personal leadership of their King.

Trained, disciplined men, commanded by their own officers, and inspired by the presence of some of the greatest nobles of France. An army of the first degree fighting for the very existence of the old feudal order.

Arrayed against them they had *as a visible enemy* an undisciplined rabble, ill-armed, ill-clothed, indifferently drilled, but *as an invisible foe* the micro-organisms of dysentery, active, vigilant and lethal.

The great Prussian leaders knew so little of hygiene as to let their troops fill empty stomachs with green grapes with the result that the Republican rabble, with their allies the bacilli of dysentery, drove the finest troops of Europe out of France and established the tottering Republic on so firm a basis that it shortly became the sponsor of the great commander, whose glorious compaigns are the constant study not merely of soldiers but of the world. Instances might be multiplied from military history where disease has paralyzed military efficiency, but we need only quote the fact that Napoleon himself lost 40,000 men round Paris from typhus fever after the retreat from Moscow.

Again, in 1870, the French lost 23,000 men from small-pox, whilst the Germans, who were exposed to the same infection, but efficiently re-vaccinated, lost only 200.

What might those lost battalions not have meant to the First and the Second Empire ?

It must be understood that a large proportion of, perhaps most, diseases, are caused by living germs growing in the body. Nearly all these germs belong to the class known as bacteria, which are minute fungi but a few such, as malaria, sleeping sickness, and syphilis are due to minute animals, known as protozoa.

The bacteria are divided into classes according to their shape.

These little fungi can be cultivated in various kinds of soil like any other vegetables, and therefore the bacteriological laboratory is merely a microbe farm.

The classes are—

1. Bacilli or rods, such as the bacillus of typhoid.
2. Spirilla or corkscrews, such as the spirillum of cholera.
3. Cocci, or little balls, such as the micrococcus of Malta fever.

These tiny fungi and minute animals are spread about by

1. Water.
2. Food.
3. Air.
4. Dust.
5. Flies.

By safeguarding these means of distribution we can limit many if not all diseases.

In the prevention of germ-caused disease the condition of the body is our first consideration.

Perfectly healthy tissues can, and do, resist the growth of most germs, therefore, in order to make the soil barren for disease, all causes which depress health and vitality should be avoided. Such causes are—

1. Intemperance
2. Indolence.
3. Immorality.
4. Irregularity in work, sleep and meals.
5. Uncleanliness.
6. Improper food.
7. Improper clothing.
8. Impure water.
9. Impure air.

To adopt military parlance there are four ways in which an army can render itself efficient against a foe.

1. It can prepare to meet him in times of peace.
2. It can attack him in his own territory.
3. It can resist invasion.
4. It can fight a pitched battle with the foe.

Let us proceed to apply these principles to disease prevention. The first line of defence is to keep the body healthy, especially as in military service there are so many agencies which tend to lower the vitality of men.

The chief of these are—

1. Ignorance and carelessness of large bodies of men.
2. Overcrowding.
3. Fatigue and exposure.
4. Improper food.

The removal of the first of these agencies is the objects of books of this nature, and its complete elimination from the risks of a campaign might mean more than can be realized as we will try to show.

In some diseases, as is well-known, it is impossible for even healthy tissues to resist the attack of germs, and therefore, we must adopt special precautions to prepare for them in times of peace, *i. e.* when the tissues are still healthy.

The most important diseases of all armies, especially in the field, are typhoid fever and dysentery.

In South Africa these two diseases accounted for one-sixth of the admissions to hospital, and one-third of the total deaths from disease.

The causes of these, as of all other diseases, are best considered under the two headings:—

1. The predisposing causes.
2. The exciting causes

The predisposing causes of enteric and dysentery may be enumerated as they apply to practically all the ills that military flesh is heir to in all climes. They are :—

1. Impure air.
2. Uncleanliness.
3. Pollution of soil.
4. Errors in diet and especially neglect of "gunfire," or the little breakfast, amongst young soldiers.
5. Fatigue and exposure.

These various headings will be referred to in detail subsequently.

The actual exciting causes are minute bacilli closely resembling one another in appearance.

Since the days when dysentery ravaged the army of Henry V. at Agincourt till quite recently the reason why these two diseases should invariably dog the footsteps of an army in the field was a perennial problem for the military sanitarian and it was ingeniously maintained by some that a microbe which normally inhabits the intestines, called the Common Colon Bacillus, could, under special conditions, develope the lethal properties of the bacilli of typhoid and dysentery. The cause is now, however, quite clear, as during the past few years, it has been discovered that individuals, who have had intestinal disease, frequently harbour the microbe of the malady in their intestines for many years after recovery.

They become what are called "carriers" of the disease. Under conditions of life in England, and with the water carriage system of sewage disposal, these individuals, unless they have to do with the handling of food supplies, are harmless.

Should, however, some of these apparently healthy individuals become portion of an army in the field their danger, as foci of infection, becomes at once apparent.

Their dejecta are exposed to the action of flies in field latrines, and the microbes these contain gain access to food or water.

The organisms multiply very rapidly, and the result is that individuals are exposed to infection under the predisposing agencies always at work in lowering the vitality of the soldier in the field. The fact that the dejecta of an apparently healthy individual may be a source of the most potent danger must be grasped by every military commander, as it makes it apparent that the smallest details of sanitation are by no means beneath his consideration, as it is of little use to train men elaborately in all the arts of war if, through faulty sanitation, they are to fall victims to the typhoid germs carried, all unwittingly, by a comrade.

In the attached table we give a summary of the causes, symptoms and means of prevention of the chief communicable diseases of military interest, but enteric fever and malaria claim some special attention.

It will be observed that we have used the word communicable instead of either contagious or infectious, as we shall presently show that a disease may be communicated from man to man by other means than so-called contagion or personal contact. Everybody in India is, of course, aware that malaria is spread by mosquitoes and by them alone. The disease itself is caused by a minute animal which lives in the red blood cells of the blood and destroys them by the million.

There are in every Indian community individuals suffering from malaria. These persons are not in the least dangerous to us as small-pox is dangerous. We cannot catch malaria directly from them, but with the assistance of a few mosquitoes of the Anopheline type the malarial-infected individual becomes just as dangerous as a case of any other communicable disease.

The parasite grows in the blood and is sucked into the stomach of the mosquito. Here it developes into a bundle of thread-like bodies. The bundle attains a considerable size and then bursts and soon the thread-like bodies pervade the entire interior of the insect.

Amongst other parts these bodies enter the salivary glands, and when the mosquito bites an individual it introduces with the poison, which it always instils, some of these minute malarial parasites. On entering the blood, the little animals attack the red blood cells, very rapidly develope, and in a period varying from 36 hours to 15 days, according to the type of parasite, produce the symptoms so painfully familiar to us in India, and known to the soldier as "Fever and Ague."

The prevention of malaria is a problem ever with us in India. We have summarized the main lines of defence in the Table, and must emphasize the fact that without mosquitoes there cannot be malaria, and that if you wish to be free from fever you must get rid of breeding grounds for them.

A word or two, therefore, in reference to the mosquito. In malaria, as in many of the troubles of this world, it is a case of *cherchez la femme.*

The male mosquito is a vegetarian and a perfectly harmless individual, whereas his mate is, as we know to our cost, a voracious cannibal.

The lady mosquito is a somewhat fastidious person. She always deposits her eggs in water, and she prefers stagnant puddles or sluggishly flowing streams, and has a great predilection for weed-choked drains, and small pools of water, such as collect in empty tins, gurrahs, &c. She prefers dark places and the little pools which collect in bath rooms and under trees are great favourites of hers. The eggs develop into little larvæ which resemble tiny tadpoles, and these after swimming about for a week or ten days develop into the dangerous little insect. The mosquito flies no further than she can help to feed, but she has been known to fly a quarter of a mile. She dislikes wind and loves the shelter of foliage. The malarial-carrying mosquitoes are not noisy ladies, they do their work quietly as a lady should. Pictures are drawn showing that the malarial mosquito always stands on her head whereas the innocent members of the mosquito family rest in a horizontal position, but unfor-

tunately it has been shown that the Anopheles M. Culicifacies, a well-known malaria carrier, behaves like the varieties at present regarded as harmless. War must therefore be waged on all mosquitoes.

Mosquito nets are a powerful protection against mosquitoes, but unfortunately the lady is at her hungriest just after sundown when nets are not in use.

The Japanese used with great success mosquito veils which were worn over the head after sunset. (*Vide sketch.*)

Failing these the feet and hands should be covered after sundown, and the utility of boots instead of shoes, and of thin drawers in protecting the lower part of the body must be obvious.

Let us again remind the reader that the mosquito is merely a carrier and that a supply of malarial blood is necessary to make its bite infective. Natives, and especially native children, are positive reservoirs of malarial poison, and though the unfortunate officer is unhappily unable to banish them from his proximity at night, they should certainly be kept out of the lines of British Troops after sundown. Similarly, it must be remembered that infected troops are a possible source of danger to new arrivals.

All standing water within a quarter mile radius of barracks should be drained, or if this is impossible, it must be treated with a mixture of one part of tar to four parts of kerosine oil once a week.

This preparation forms a layer on the surface of the water which suffocates the larvæ of the mosquitoes. Large pools and slowly moving streams are best treated by throwing in stones wrapped in rags saturated with the kerosine and tar mixture. The oil keeps constantly rising to the surface and replacing the film as it is blown away by the wind or carried away by the current.

In relation to the prevention of typhoid the question of inoculation must loom largely. It is rather a curious thing

that whilst few soldiers would dream of resisting, or refusing vaccination there are still some who do not consent to inoculation or vaccination against enteric.

This is due to a misconception that vaccination against small-pox and inoculation against enteric are two widely different procedures.

Nothing of the kind. Both aim at giving the individual the disease against which protection is sought in a mild form, or producing a condition resembling it, and, thereby, increasing the resistance of his blood to the disease.

The blood consists of three parts—red cells, white cells, and serum or watery fluid. The red cells are solely concerned with the supply and nourishment of the tissues, whilst the two latter constituents do all the fighting against disease.

When a microbe effects a landing in the body the white cells, aided by agents in the watery fluid, proceed to attack the organism and to destroy it.

If a patient has had an infectious disease it is well-known that he developes a power of resisting the malady and, in fact, becomes more or less immune to it.

Prior to the introduction of vaccination, small-pox was so common that people were willing to go to any length to avoid it, and inoculation of persons with matter from the pocks of small-pox was largely practised.

It was found however that inoculated persons did not always develope mild attacks of the disease and often became foci for its distribution and the practice had to be stopped by law.

Dr. Jenner discovered that people working with cows developed an inflammatory condition from a disease of the cows' udders and became thereby immune to small-pox.

He came to the conclusion that cow-pox was merely small-pox, which had become attenuated by passing through the cow's body and introduced the process which we now call vaccination

It aims at giving the individual a mild form of small-pox and, thereby, increasing his power of resisting the disease.

Working on similar lines Professor Wright of Netley discovered a method of increasing the resisting power of the blood against the enteric bacillus without actually giving the disease, and it is this principle which is utilized in anti-typhoid inoculation.

The inoculation fluid is nothing more than a culture of the enteric vegetable killed by heat, with a disinfectant added, which renders all possibility of an occasional microbe escaping death absolutely out of the question.

It is very little more dangerous than many other stewed vegetable material and, as it is absolutely sterile, and injected with every conceivable care, not a whit more dangerous than ordinary vaccination

The following figures, published by the P. M. O., H. M. Forces in India, show the results of inoculation against Enteric Fever in sixteen corps in India and the Colonies between the period October 1905 and April 1908.

	Inoculated.	Not-inoculated.
Strength	5,473	6,510
Cases of enteric fever	21	187
Deaths	2	26
Case incidence per 1,000	3·8	28·3

The figures show that the inoculated man has a much better chance of escaping enteric altogether than the non-inoculated, and if he does get the disease he has a 7 to 1 better chance of getting well than the man who has declined it.

The case of the 17th Lancers at Meerut is a very striking one.

The regiment encountered an enteric epidemic shortly after arrival in India. There were 60 cases of enteric altogether.

Of these cases, 58 had not been inoculated whilst the remaining 2 had not had their second dose of the vaccine. The men who had been fully inoculated escaped the disease altogether.

Summer uniform of Japanese Soldier showing buttonless khaki drill coat and mosquito helmet over the head and forage cap. Reproduced, by permission, from the *British Medical Journal*.

We think these statistics are absolutely unanswerable, and that the officer or non-commissioned officer who does not use every means in his power to persuade his men to adopt this means of prevention takes on a very serious responsibility.

The protection afforded against typhoid lasts for at least two years, but the resistance of the blood to the typhoid organism remains as high as four times the normal for as long as six years.

It is not pretended that the method will as absolutely protect against typhoid as vaccination will against small-pox, because enteric and small-pox are different types of disease.

One attack of small-pox is, practically, an absolute protection against another, but one attack of enteric, although it renders second attack uncommon, is by no means an *absolute* protection. In conclusion anti-typhoid vaccine may be compared to quinine. Would any individual be justified in withholding quinine from the inhabitants of a malarial country ? Similarly, as in this country every article of food and drink, and every particle of dust inhaled, is a potential source of enteric, the individual who withholds the weight of his counsel and advice in securing the wide adoption of a method of prevention which has the approval of every medical and scientific mind in Europe and Asia, must have feelings which we do not envy him when he hears that one of his comrades—perhaps his dearest friend—has gone to hospital with enteric fever.

The following excellent notes on the prevention of this disease were circulated by the G. O. C., Kohat Brigde, two years ago, and are now published through the courtesy of Colonel C. H. Beatson, C. B :—

1. Articles of food and drink for consumption in their residences by unmarried officers should, if possible, be obtained from their Mess. Milk, butter, soda water, &c., from unauthorized sources are often highly impure.
2. It is much safer to boil all milk and drinking water.

3. A small "safe" for storing articles of food, &c., till required is as much a necessity in bachelor's quarters as elsewhere to prevent contamination by flies, dust, &c.

4. Water taken from irrigation channels should never be used for any purpose in the kitchen. Neither cooking vessels nor plates, dishes, jharans, &c., should ever be washed in such water.

5. All drinking water should be brought from the standpipes in metal vessels kept exclusively for the purpose.

6. Lettuce and water cress, which are eaten raw, are very likely to cause disease as they are watered by and very generally washed in irrigation water after being plucked.

7. It has to be recognised that no process of hardening against enteric germs takes place, so far as is known, from continued disregard of precautions. An individual, predisposed to the disease, and imbibing the specific germ, will certainly not escape. More especially so if he has been exposed to the enervating influence of great climatic heat or exhausting exertion under a tropical sun.

COMMUNICABLE DISEASES

OF

SOLDIERS.

Disease.	Mode of Infection.	Period between contracting disease and outbreak of symptoms.	Character of onset.	Chief symptoms and appearance and colour of Rash (if any).	Primary situation of Rash.
Ague or Malaria.	Through mosquitoes which bite infected persons and long afterwards, convey the parasite to healthy individuals.	36 hours to 15 days.	Sudden ..	Three stages:— 1. Cold. 2. Hot. 3. Sweating.	..
Chicken-pox.	By direct contact with a person suffering from the disease.	A fortnight.	Sudden ..	On 1st day of illness small red pimples appear in crops, rapidly passing into little pearly blisters.	On back, chest, abdomen, and covered parts.
Cholera ..	From excreta through water, milk, food, dust, flies or clothing.	2 to 5 days.	Sudden ..	Three stages:— 1. Diarrhœa. 2. Vomiting, cramps, rice-water stools and collapse. 3. Re-action.	..
Diphtheria (or so-called Membranous croup).	Through breath, also carried by cats and fowls.	2 to 7 days oftenest 2.	Gradual ..	1. Sore throat. 2. Difficulty of swallowing. 3. Paralysis.	..
Dysentery ..	As Enteric ..	36 hours to 7 days.	Gradual ..	Three characteristic symptoms in acute cases: 1. Diarrhœa. 2. Cramps and straining. 3. Blood or mucus in stools. Blood is by no means always present in true dysentry.	..
Influenza ..	Through breath, clothing, &c. Readily carried from place to place in trains, &c.	1 to 4 days; oftenest 3.	Usually abrupt. (*Osler*).	Herpes, or "breaking out of a cold," is common. Diffuse red blush or purplish mottling are sometimes seen.	Herpes, if present, appears round mouth.
German Measles.	Direct contact.	10 to 12 days.	Sudden.	Round or oval slightly raised spots, pinkish in colour, appear on 1st day.	Face, then chest, and gradually spread to whole body.

Range of Temperature.	Rash fades.	Duration of Illness.	Duration of Infectivity.	Preventive measures.	Quarantine periods for contacts.
May reach 106°.	..	Varies with type of fever.	So long as parasites are to be found in blood.	1. Aim at the extermination of mosquitoes of all kinds. 2. Protect from mosquito bites. 3. Take Quinine. The drug only remains in the blood for 4 days; therefore 15 grains should be taken twice weekly.	There are three types of malaria due to different parasites. Two of these varieties are readily cured by quinine whilst the third is not.
Not usually above 100°.	Scabs form about 4th day of fever.	4 to 7 days.	2 weeks ..	Isolation and disinfection.	20 days.
Never high. There may be none.	..	A few hours to several days.	Till discharges free from Cholera bacilli.	1. Drink nothing but tea or boiled water. 2. Avoid raw fruits and uncooked vegetables. 3. Seek medical advice for the slightest digestive disturbance.	5 to 10 days.
Up to 103°.	..	Variable ..	Person may be infective for 6 weeks.	Isolation and disinfection. Antitoxin is a good preventative.	12 days.
Never high.	..	Variable ..	Whilst the bacilli or amœbæ which cause disease are to be found in the stools.	1.—Isolation. 2.—Disinfection of excreta.	There are two varieties one due to bacilli and the other to a minute animal.
Variable. May be only symptom in feverish type or absent in nervous variety.	There are 4 types of the disease:— 1.—Catarrhal; affecting respiratory tract from nose to lungs. 2.—Nervous; headache, backache and prostration. 3.—Intestinal; diarrhoea and vomitting. 4.—Feverish; may simulate typhoid.		2 to 6 weeks, according to type.	Strict disinfection and isolation.	Nearly every variety of ill-health has been said to follow influenza, if neglected. If treated early complete recovery is the rule.
100° highest.	3rd day	4 to 5 days ..	1 week ..	Isolation and disinfection.	20 days.

Disease.	Mode of Infection.	Period between contracting disease and outbreak of symptoms.	Character of onset.	Chief symptoms and appearance and colour of Rash (if any)	Primary situation of Rash.
Hydrophobia	Bites of infected animals (dogs, wolves and cats.)	7 days to 2 months.	Gradual.	Restlessness, irritability and difficulty in swallowing. Convulsions of throat and respiratory muscles follow: Death is due to suffocation or exhaustion.	..
Measles ..	By the breath.	1 to 2 weeks.	Sudden ..	Appears on 4th day of disease. Dull red blotches, velvety to touch.	Behind ears, and on forehead and face.
Mumps ..	By direct contact.	14 to 21 days.	Sudden ..	None	..
Plague ..	Through air and indirectly from rats through fleas.	3 hours to 15 days. Usually 2 to 8 days.	Sudden ..	A rash resembling flea bites is common but not constant.	Face or chest.
Pneumonia ..	Through air, sputum, food, or indirectly through a third person.	18 hours to 5 days.	Sudden ..	Rigors, cough, headache and rusty sputum.	Herpes round nose is common.
Typhoid or Enteric.	From excreta, through water, milk, food, dust or flies.	14 to 21 days.	Gradual ..	A few rose-coloured raised spots. Frontal headache, lassitude peasoup stools, or constipation.	On abdomen.
Typhus or Camp Fever.	Through air and indirectly through fleas.	12 days ..	Sudden ..	Mulberry coloured spots, parrot tongue, flushed face and delirium.	Abdomen and upper part chest.

Range of temperature.	Rash fades.	Duration of Illness.	Duration of Infectivity.	Preventive measure.	Quarantine periods for contacts.
None ..	There are two types in animals :— 1. *Furious*, characterized by restlessness, irritability and altered bark. Fear of water is not a symptom. Animal tears and worries unusual substances. 2. *Paralytic*, characterized by paralysis of jaws, loins, and hind legs.			1. Cauterize bites of all dogs, &c. with a fluid caustic such as nitric or carbolic acid. 2. Preventive inoculation at Pasteur Institute.	A dog or cat which has bitten a man should not be destroyed but kept under observation for a month.
Up to 103° ..	On 7th day of fever.	10 days ..	3 weeks. Is very infectious before rash appears.	Isolation and disinfection.	16 days.
101° highest.	....	7 to 10 days.	2 weeks ..	1. Isolation. 2. Disinfection, do *not* treat as a trivial malady as native soldiers sometimes die of the disease.	24 days.
Varies with the type. There are three varieties :— 1. Bubonic. 2. Septicaemic. 3. Pneumonic.	Variable ..	About a month; many cases die on 3rd to 5th day.	6 to 8 weeks.	1. Isolation and disinfection. 2. Destruction of rats 3. Preventive inoculation. 4. Protection of feet and hands and especially abraded surfaces.	12 days.
Very high.	....	Crisis may be expected on 6th to 8th day.	14 days ..	Isolation and careful disinfection.	7 days.
Lower in morning than in evening.	Variable ..	21 days or longer.	A month or longer.	1. Isolation. 2. Disinfect. most strictly, all urine and stools, and everything that has touched patient. 3. Preventive inoculation. 4 Habitually avoid fruit without skins and uncooked vegetables. 5. Destroy flies.	All contacts and orderlies who have been nursing enteric cases should be quarantined for one month.
May rise to 107°.	End of second week.	Crisis on 14th day followed by rapid convalescence.	5 weeks ..	Isolation and disinfection.	16 days.

Disease.	Mode of Infection.	Period between contracting disease and outbreak of symptoms.	Character of onset.	Chief symptoms and appearance and colour of Rash (if any).	Primary situation of Rash.
Relapsing Fever.	Direct contact or through bugs or fleas.	4 to 10 days.	Very sudden.	Rigors, giddiness, high fever.	Flea bite like spots appear all over body.
Small-pox ..	Through the air from the skin and breath.	14 days ..	Sudden backache very marked.	Small red pimples, becoming pocks, similar to those seen in vaccination, appear on 3rd day.	Face and exposed parts.
Scarlet Fever (Scarletina is not a different and mild form of the disease, but merely the Latin for Scarlet Fever).	By breath, mucous discharges, clothing, books and scales from skin.	3 to 7 days.	Sudden.	On 2nd day bright scarlet mottling, cheeks look as if they had been rouged, and there is a marked pale circle round the mouth.	On chest ..
Tuberculosis	Through air from sputum or through milk.	Uncertain.	Gradual.	Fever, debility and wasting.	....
Yellow Fever	Through a special breed of mosquito.	2 to 5 days.	Sudden.	Three or four days fever followed by black vomit, and bloody urine.	The whole body turns yellow.
Malta Fever..	Through goat's milk..	6 to 17 days	Gradual ..	Headache, boneache, rheumatic inflammation of joints.	....

Range of temperature.	Rash fades.	Duration of Illness.	Duration of Infectivity.	Preventive measure.	Quarantine periods for contacts.
High ..	Variable ..	Fever lasts for a week ends by crisis and after a week starts all over again: as many as five relapses may occur.	6 weeks ..	Avoidance of overcrowding and low dietary. Disinfection.	14 days.
High at onset, drops when rash appears, and rises when "matter" appears in pocks.	Scabs form on 9th or 10th day, and begin to fall off on 14th.	14 to 21 days.	About a month. A corpse is as infective as a living person. "The dead are dangerous."	All persons coming in contact with cases must be vaccinated.	16 days.
Up to 105° ..	On 5th day of fever.	10 days *if there are no complications.*	6 to 8 weeks, or until "peeling" has ceased.	Isolation and disinfection.	10 days.
Slight early in the disease.	..	Variable ..	In tubercle of lung exists throughout the disease.	1 Isolation of infected person. 2. Disinfection of clothing, etc. 3. Efficient inspection of milch cows.	21 days.
Very high ..	Yellow coloration persists throughout the disease.	Mild cases a week; severe, a fortnight or longer.	Only infective 2nd and 3rd day of fever.	1. Destroy the mosquito. 2. Prevent its access to water tanks. 3. Mosquito nets.	10 days.
Gradual rise to 104° gradual fall to normal with one or more relapses.		Average is four months	..	Avoid goat's milk ..	..

CHAPTER II.

Air and Ventilation.

"*Our individual moral responsibilities with regard to the air we breathe are great. Our first duty is not to befoul the air more than we can help, to keep all about us clean and pure inside our houses, and our rooms free from dust and not to allow accumulation of refuse outside.*"—*Newman's Health of the State, p.* 68.

"The mistake of most modern ventilation is that there is not enough of it." So writes Dr. Ransome in a recent learned treatise on the treatment of pulmonary disease.

If the principle that persons with diseased lungs cannot have too much fresh air be conceded, surely the necessity for an abundant supply for healthy men must be sufficiently obvious.

It is well-known that the blood is the medium by which various food materials and oxygen are carried to the tissues and organs of the body for their growth and nourishment.

The food is of course obtained from the digestive system, whilst the oxygen is absorbed from the air we breathe.

The tissues not only absorb nourishment from the blood but also pour into it their own waste products. This waste material is largely disposed of in the lungs.

The lungs are, therefore, a sort of exchange where oxygen is absorbed and waste products added to the air.

If the respired air is impure and the lungs are unable to absorb oxygen from it in sufficient amount the nourishment of the whole body is lowered.

It is, as Dr. Newman points out, on this simple principle of physiology that all need of fresh air, and therefore, of ventilation is based.

To understand the subject it is necessary to know—

1. The constituents of the atmosphere and the chief sources of its impurity.
2. Nature's agents for purifying the air.
3. Our artificial means of supplying the individual with fresh air.

Let us consider these seriatim—

1. Fresh air consists of a mixture of gases, some water and a certain amount of solid matter in very fine sub-division.

The chief constituent from the point of importance is oxygen, but from the point of quantity nitrogen.

Oxygen is a colourless tasteless gas which burns up any material exposed to it, whilst nitrogen has no specific properties as a portion of the atmosphere, and merely acts as a diluent of the potent oxygen.

In addition to these two constituents the air contains, in varying amounts, a third gas, which differs from the other two in being poisonous if breathed in large quantities.

Except in rare instances, it is however not found in the air in sufficient quantity to produce *per se* serious results, but its presence is of the greatest value to the sanitarian as it serves as an indicator of the organic material and microbes which constitute the real danger of foul air.

Besides these three gases which constitute the vast bulk of the air, some other substances are found in it, such as ammonia, marsh gas and sulphur compounds; but these constituents are by no means constantly present and rarely exist in other than negligible quantities.

The chief sources of impurity of air are—

1. Products of respiration.
2. Products of combustion.
3. Products of decomposition.
4. Dust.

1. *Products of Respiration.*—By respiration we mean not only the vital act of breathing but the peculiar action of the skin which must be regarded as a great aid to the

lungs in getting rid of waste products of the body. The importance of the daily bath in training is, therefore, obvious, as it aids the lungs by keeping their chief auxiliary, the skin, in good working order. Respiration adds to the air—

1. Carbonic acid.
2. Water.
3. Dead tissue.
4. Germs.

The proportion of the last two added to the air varies greatly, but the quantities of carbonic acid added is comparatively constant.

In round numbers 4 per cent of oxygen is abstracted from the air in the lungs, whilst 4 per cent. of carbonic acid is added to it. Expired air is usually saturated with watery vapor, but the exact amount of water added, of course, varies with the degree of saturation which obtains in the air breathed.

2. *Products of Combustion.*—The chief products of combustion which concern the soldier are carbonic acid and carbon monoxide.

It is very desirable that every soldier should appreciate the difference between these two gases. When you look at a fire burning in a grate, you are unconsciously witnessing the process of a chemical combination. The carbon of the wood, coal or charcoal is uniting with the oxygen of the air, to form one of two chemicals, either carbonic acid, which is a *comparatively* harmless compound and which we consume in large quantities in aerated waters, and carbon monoxide, an active narcotic poison.

It is this latter gas which is the source of danger when an *angethi* is burned in a tent. The French grisette, when her lover proves faithless, shuts up the doors and windows of her bed-room, lights a charcoal stove, fixes it so that the smoke escapes into the room, and goes to bed to presently fall into "the sleep which knows no waking."

A similar foolish procedure is occasionally pursued by soldiers on cold nights in camp or on the march with far

from suicidal intentions. Several cases of partial poisoning due to charcoal fumes have occurred, so that the poisonous gases given off by any kind of stove, and especially by a charcoal angethi, is a sanitary consideration worth remembering.

3. *Products of Decomposition.*—The only practical point in this connection is that decomposing vegetation produces poisonous and inflammable gases, so that a heap of rotting leaves, &c., which may often be found outside a bedroom in India is a thing to be avoided.

4. *Dust.*—This is a source of impurity of the greatest importance to us in India. The following ingredients may be found by microscopical examination of ordinary bungalow dust :—

1. Bits of charcoal.
2. Bits of cotton and other fabrics.
3. Bits of skin.
4. Bits of insects.
5. Bits of hay and straw.
6. Dried sputum.
7. Dried bits of excrement.
8. Germs anchored on to all these various particles of matter.

The harmless-looking motes which we see dancing in the sunshine are, therefore, very frequently as dangerous as cordite, and constitute, not merely an undesirable, but a positively disgusting mixture.

Rooms should, therefore, be constructed to facilitate the removal of dust.

Everything which is likely to give a lodging to it should be vigorously excluded from the barrack room and the bungalow.

It would be difficult to imagine anything less adapted to facilitate the removal of dust than the floor of the Indian barrack room and the floors of the average Indian bungalow, especially on the frontier.

Badly laid bricks with wide intervals between them and rammed earthern floors are the order of the day: and in bungalows, to make matters worse, the badly-made floor is covered with a kind of matting which cannot be removed.

Every step in many Indian bungalows is made over a good thick layer of the disgusting mixture of which the reader now know the ingredients.

Nor is this all. The average Britisher in India leaves all his dusting to two servants—his bearer and his sweeper. The former's idea of dusting is to flick a *jharran* at an article in the hope that he will hit some of the dust and that when he has displaced it into the air it won't fall again in the same spot and offend his sahib or memsahib's eye. That he should aim at removing it from the room never occurs to him. The sweeper's method is to keep *one* small twig broom, which is his badge of office, and to use it for every purpose.

He sweeps up the drive, the kitchen, the stable and the best dhurrie or carpet with the self-same article. It would be difficult to imagine a more disgusting practice, and we suggest that the Knight of the Broom should be supplied with a special implement for indoor use. The apparatus is not costly, and we feel sure that a little more attention to details of this nature might make life easier and healthier in this country. Again, a few lessons in the use of a damp cloth for dusting or in the value of tea leaves or wet saw dust before sweeping out rooms might be useful in barracks and at home.

2. Nature's agents for purifying the air are—
    1. Rain.
    2. The action of sunlight.
    3. Plants.

Rain is simply a mechanical purifier. It washes the air. Sunlight has the power of killing germs, whilst plants absorb carbonic acid from the air and give off oxygen. No better illustration of the ceaseless cycle of matter can be conceived.

than the consideration of the course and transmutation of this carbonic acid gas given off by the lungs.

Though we exhale it as a waste product every time we breathe, though it is thrown off in enormous volumes by gas jets, fires and furnaces, it never accumulates in the free air of heaven around us ; for the economy of nature tolerates no waste—no accumulation of effete matters. This gas, which is so inimical to animal life, is ordained to be indispensable to vegetable life. We exhale it and plants inhale it, so that every tree which is left to grow in the crowded Indian city and every plant in the village garden, transmutes it by the heat of the sun into blossom and leaf and stem, imprisoning the carbon and setting the oxygen free. The coal, which we now burn so generally in India was made up, long ages ago, of plants and trees fed by the nourishing heat of the sun from the carbonic acid in the air, and both the heat and the carbonic acid are returned to us as we sit in front of the blazing fire. And so, although we cannot re-breathe this gas without injury, we can use it as food in our vegetables and transmute the heat pent up in the leaves and roots into the warmth of our bodies, the strength and activity of our limbs and even the very thoughts which flash from our brains. Speaking of fires, suggest to us that in a station with a markedly cold season the importance of ventilation of bedrooms requires emphasis.

It is not always realized that soldiers spend nearly a third of their service asleep. They have, generally speaking, a rooted dislike for "night air," and it is desirable that their officers should explain to them that the air after ten p.m. may be colder but does not take on any poisonous characters which it did not previously possess.

Provided you are guarded against the lady visitant of whom we spoke in chapter I, the best place to sleep is that most exposed to the four winds of heaven.

Climate was formerly believed to be essential in the treatment of consumption, but it is now known that it is the fresh air and not the particular locality which effects the

cure. Consumptive patients in quite advanced stages, get well living and sleeping in open shelters on Dartmoor in the depth of winter. The snow not infrequently finds its way on to their counterpanes, but as they have sufficient blankets the very low temperature produces no bad results.

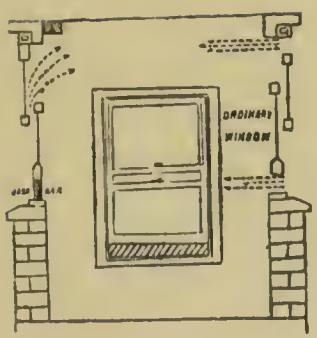
Night air, therefore, even mixed with a little snow, has no terrors for the sanitarian.

Nothing has produced a greater improvement in the health of the Army than the appreciation by the authorities of the necessity of fresh air for the soldier.

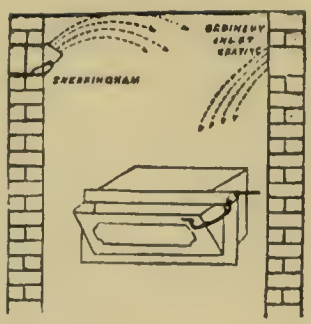
Some years ago the death rate from consumption in the Guards was three times that of the Civil population, now it will compare favourably with it.

About fifty years ago 10 or 12 men out of every battalion died yearly of consumption, now the average is not more than two.

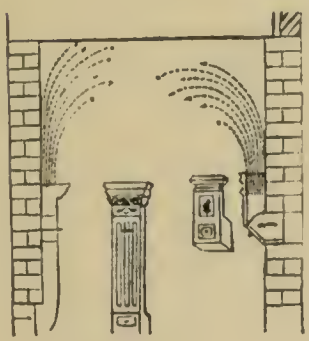
3. It is not necessary to discuss the varieties of ventilator found in barracks in any detail. The attached drawings (after Knight's Diagrammettes) show the chief methods in use sufficiently clearly. In most works on hygiene attention is drawn to the fact that a very lofty room is not necessarily a healthy one. Carbonic acid and the dangerous organic compounds, which are exhaled with it are heavier than air and sink down to the ground, so that it is generally accepted that for practical purposes of ventilation, in temperate climates, all height above 12 feet may be ignored. This rule may, however, be disregarded in this country, *in the hot weather*, as the punkah if acting efficiently should keep the whole of the air of a room, however lofty, in circulation. During the Indian hot weather our system of ventilation is peculiar. We endeavour to imprison a large quantity of cool air in our bungalows soon after sunrise and keep it in motion during the day by means of fans. Of course our results must be merely approximate as the cool air of the night is gradually and, indeed, sometimes very quickly replaced by the sun-scorched air of the "long long Indian day."



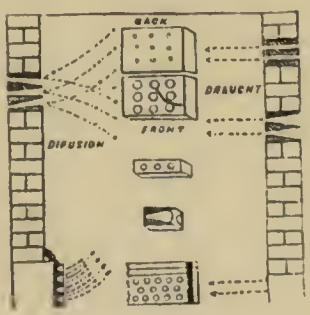
HINCKES-BIRD'S WINDOW INLET.



SHERRINGHAM VALVE INLET.



TOBIN'S TUBE INLETS.



ELLISON'S AIR INLETS.

Note that the principle of all these methods is to direct the incoming cold air towards the ceiling and thus minimize "draughts."

With reference to the punkah in Indian barracks, all will agree with us in repeating our first quotation that "the worst of it is there is not enough of it."

We cannot, but believe, that any mechanical contrivance which would improve on the present motive power of punkahs in barracks would be the greatest boon yet conferred on the soldier in India.

With reference to the punkah, it should be pointed out that even with a good punkah one is not entirely free from the visits of the lady mosquito.

Being as we have seen like most of her sex fastidious in her dislike of draughts, she avoids the parts of her host over which the fan is acting and devotes her attention to the feet or the armpits which are out of reach of the punkah. The importance of wearing light stockings and keeping the pyjama jacket carefully buttoned up are, therefore, important little points worth remembering if we wish to avoid fever.

An important aid to ventilation not usually figured in the text books is the tooth brush.

Pure air is often fouled by dirty teeth. Many soldiers breathe through a festering mass of corruption, which is usually if not always, the result of neglect of the tooth brush.

Tooth brushes are now a portion of the soldier's kit, but experience goes to show that they are only too frequently kept for kit inspections.

The mouth is always full of microbes, and is one of the most important and most difficult parts of the body to keep clean.

If we look upon it as our chief personal air inlet, it is surely as important to see that men keep this ventilator in order, as to see that they do not block up the Sheringham's valves and Tobin's tubes in their barrack rooms. Tooth picks are as useful as tooth brushes in keeping the mouth free of food debris, which decomposes in what is, practically, an incubator and hatches out all sorts of microbes.

We hope to see tooth picks for sale in dry canteens at no distant future.

There is another point which has a practical bearing on ventilation, and that is the practice of spitting. Sputum is a ready source of infection and a constant constituent of bungalow dust.

All, of course, are aware that it is a ready means of spreading consumption, but it is not generally realized that it also spreads many other diseases notably influenza and pneumonia.

Another point in relation to ventilation is the keeping of pets.

Of course pets are not *supposed* to be kept in barrack-rooms, but all the same they sometimes find their way there.

Monkeys are very subject to consumption, and parrots suffer from a peculiar disease due to a bacillus closely allied to the typhoid organism.

Monkeys have been shown to have infected their masters with consumption, and, considering what bacteriology tells us parrots cannot be regarded as altogether safe sharers of bed and board. Influenza and diphtheria have certainly been spread by various kinds of domestic pets in England.

Bedding and clothing require to get their share of fresh air, just as much as the human individual.

Air is, as you have seen, the medium of conveying many diseases, but the lack of it causes not a few :—

1. Indigestion.
2. Bronchitis.
3. Pneumonia.
4. Weakness and debility.
5. Heat stroke.

This last named disease is always associated with bad ventilation.

Finally, we think that this question of fresh air is one of the most important of all sanitary questions as our ideas on ventilation and fresh air cures are quite the most modern

of sanitary measures. Pure water was as much appreciated by the ancient Romans as ourselves, but even half a century ago fresh air as a remedial measure was quite undreamt of.

At the beginning of the late Queen's reign people slept in four posters, and ventilation, as we now understand it, was unknown.

The average duration of life in an English town was 26 years in 1840. In this year of grace it is not less than 50 years. *Verbum sapienti satis est.*

The following simple chemical test for ventilation is worth remembering :—Take a 10½ ounces stoppered bottle. Fill it with boiled or distilled water, empty it in the room the air of which it is required to test. Rapidly pour in half an ounce of lime water.

Stopper the bottle and shake up well. If the lime water becomes turbid the ventilation of the room should be increased.

CHAPTER III.

Water and Water Supplies.

"It is often argued that our predecessors in India wore small hats, never protected themselves from mosquitoes, drank largely of beer and what water they drank was impure; in short, that they did with impunity a hundred things against which we are solemnly warned as dangerous. The fact is though they did these things they did not do them with impunity: for during the first half of the last century the annual rate of mortality of British troops in India was over 70 per 1,000; whereas during the past ten years it has been below 15 per 1,000."—Aldridge's Prevention of Disease in the Army.

Without water there would be no life.

The part which water plays in the animal economy is of the first importance.

It constitutes nearly two-thirds of the total weight of the body, seventy-nine per cent of the blood, eighty per cent. of brain and muscle, and ten per cent even of bone.

As we shall show in the next chapter, it forms the vast bulk of our so called solid food, whereas whatever our tastes in liquor may be, it constitutes at least 90 per cent. of the fluids we drink.

The best whiskey, for instance, consists of about 50 per cent water, and for this water some of us pay considerable sums per annum to the Excise Department.

Like pure air pure water consists of two gases, but whereas in air the gases exist loosely mixed together and in varying quantities; in water they are combined into a fixed compound which the chemists call oxide of hydrogen.

From a military point of view two principle questions present themselves, viz :—

1. The question of quantity.
2. The question of quality.

The amount of water or other liquids required by man, over and above what he obtains in his food, is about two pints in temperate climates, but a much larger quantity is consumed by most soldiers in beverages of various kinds, harmless and harmful, with the result that a much greater strain than Nature intended is thrown on the excretory organs generally, and especially on the kidneys.

It must be understood that this quantity merely means the amount to be actually drunk.

Man requires water for many purposes, and the quantity which he uses in various places is very variable.

Glasgow, for example, stands at the head of all British towns with a daily allowance per head of 58 gallons, whilst Leicester stands at the bottom of the list with an allowance of less than one-third of that amount, viz., 17 gallons per day.

In Peshawar the daily allowance per head is nearer the Glasgow than the Leicester standard, but in many Indian Cantonments scarcity of water constitutes a great hardship.

The King's Regulations allow 20 gallons daily for each adult and 10 gallons for a child (K. R. 1908, para. 1037), whilst the Field Service Pocket Book lays down that a daily average of 1 gallon per man is sufficient for drinking and cooking purposes. A horse, bullock or mule drinks about 1½ gallons at a time. In standing camps an average allowance of 5 gallons should be given for a man, and 10 gallons for a horse. So much for the matter of quantity. We have now to consider the quality of water.

Unfortunately in water, as in many things in this world, appearances are deceptive

The physical characters and palatability of a water are no guide to its fitness for drinking purposes. Many horribly polluted waters are clear, sparkling and pleasant to the taste. Filtration through a few feet of some soils readily removes the visibly disagreeable properties of the most filthy liquids, but such slight filtration does not, of course, remove their dangerous properties.

It has not unfrequently happened that the soakage from the manure heap and the cesspool of a country house have furnished a considerable proportion of the water of the shallow well from which the house obtained its water supply.

Polluted water is a virulent source of disease. It has been shown to cause the following long list of maladies :—

1. Enteric fever.
2. Cholera.
3. Diarrhœa
4. Dysentery.
5. Worms, such as Bilharzia.
6. Diphtheria.
7. Sore throat.
8. Boils and Frontier sores.
9. Indigestion.

This is a terrible indictment against water, but before considering how we can treat and safeguard our drinking water we must consider the sources of supply.

We derive our water supply directly or indirectly from the rainfall.

Water as it condenses in the clouds from the gaseous state is absolutely pure, but by the time it reaches the surface of the earth in the form of rain it has become impure. Rain, as we have seen, is a purifier of the air, but in performing this service to man it becomes itself impure.

It washes various undesirable gases and some obnoxious solids in the form of dust out of the air, and either sinks into the soil or flows along its surface in streams.

Man obtains his supply from these three sources which, according to their origin, are known as—

1. Surface water which may be either upland surface, *i.e.*, water running down hills in small streams to natural or artificially made lakes or ordinary surface water from cultivated land such as land springs, streams, and ponds.
2. River water.
3. Ground water from wells and springs.

A few details about these sources of supply are necessary.

Upland Surface Water.—Rain falling on hill sides and running down in little streams and rivulets forms the upland surface waters. A great many English towns obtain their supply from this source, which is generally a good one, as there are but few people living in these highland districts, the land is but poorly cultivated, and so the risk of sewage contamination is slight.

Rain Water.—As a means of obtaining water hardly concerns us at all in India, but in some foreign garrisons it forms a considerable source of supply.

Ordinary Surface Waters.—By which we mean water falling at low levels, and river water must usually be regarded with suspicion.

Such waters are constantly liable to pollution by men and animals.

If it were not for the beneficent purifying work of oxygen, rivers and ponds in this country would soon become little more than open sewers but, fortunately, purifying processes go on actively in river water, and if the stream has many falls and eddies the amount of oxygen dissolved in the water is so great that a moderate amount of contamination is soon got rid of.

Moreover, there are various green river plants continually at work giving off oxygen in a most active condition.

The oxidation processes in rivers is a chemical process, started by bright sunlight.

When the stream becomes thick or muddy, this process is checked or stopped, but even when this occurs, there is still a purifying action going on as a number of fish, shell-fish, cray-fish, small animalculae, microscopic plants and bacteria live on sewage or other organic debris. Unfortunately these purifying processes in most of our rivers are not sufficient to cope with the quantity of dead organic material constantly poured in from source to mouth.

The value of fish as purifying agents of water is undoubted, and it may be incidentally mentioned, that stickle-

backs and minnows have considerable value as consumers of the larvae of midges.

The Americans exported fish to Panama for the purpose of purifying the streams there and destroying the larvae of mosquitoes.

The idea has not yet been taken up seriously in this country, but some day it may become necessary to add, to the duties of the orderly officer of a troopship, to see that the sticklebacks and minnows "are properly but not excessively iced, while passing through the Red Sea." (McCabe.)

Ground Water.—The water which falls on the earth and sinks into the soil, returns to use again for the service of man as wells and springs.

Wells are divided into three varieties: Shallow, deep, and artesian.

The descriptive words are not used to indicate the relative depth of the wells, but to describe the water bearing stratum they tap. In the figure, a shallow and a deep well are illustrated side by side. The shallow well F taps the underground water of the surface layer of the soil. In the diagram, this is shown to be contaminated by soakage from cesspool and a manure heap.

The deep well E passes through an impermeable stratum B. C., and taps the water in a deep permeable stratum D. In the diagram, this stratum is shown as cropping up to form hills. This outcrop, as it is called by geologists, may be many miles from the spot where the water is tapped by the deep well. On account of the long distance which rain falling on the hills has to percolate before it reaches the well, any organic impurities which it may have obtained near the surface are filtered out. The shallow well F would represent the water supply of an average Indian village.

Such a disgusting source of water is by no means confined to India, as the water supply of most rural districts in England is graphically described in the following words of the Rivers Pollution Commissioners.

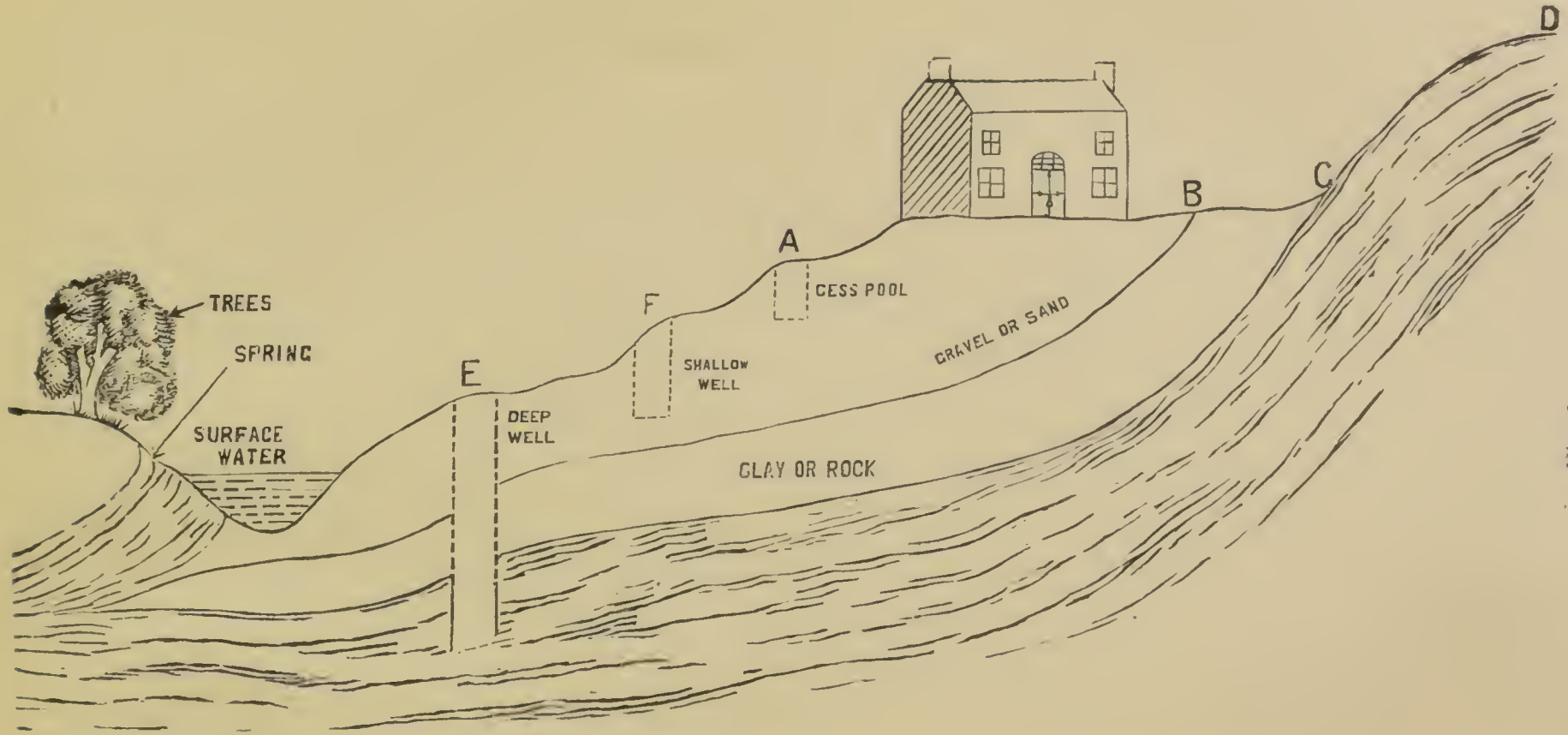
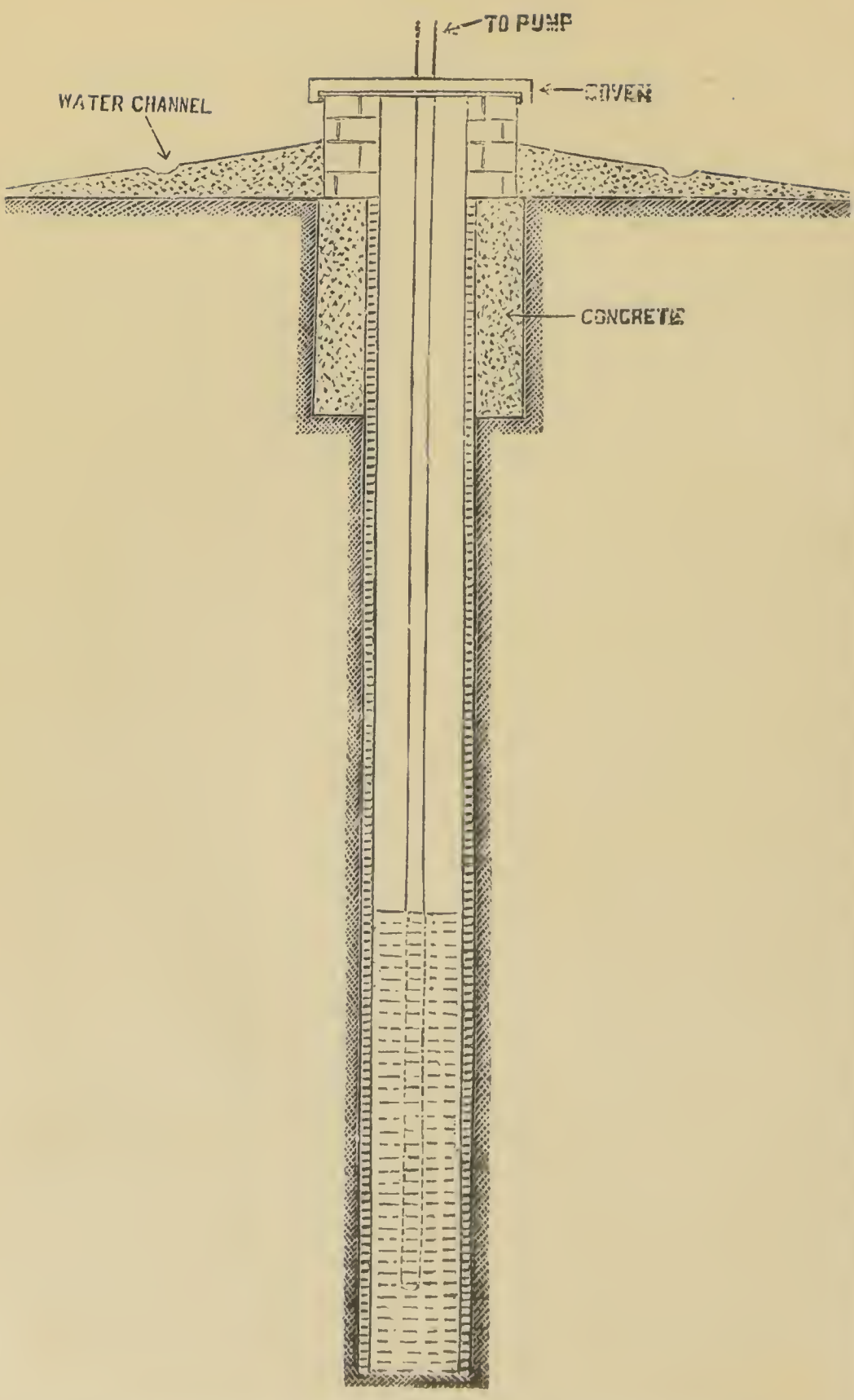

TREES
SPRING
SURFACE WATER
E
DEEP WELL
F
SHALLOW WELL
A
CESS POOL
B
C
D
GRAVEL OR SAND
CLAY OR ROCK

Fig. 1

Fig. 2.



A well, properly protected from pollution. reproduced from Notter and Firth's Hygiene by permission.

"The common practice in villages and even in small towns is to dispose of the sewage and provide for the water supply of each cottage or pair of cottages on the premises.

"In the little yard or garden attached to each tenement or pair of tenements, two holes are dug in the porous soil; into one of these, usually the shallower of the two, all the filthy liquids of the house are discharged, from the other, which is sunk below the water line of the porous stratum, the water for drinking and other domestic purposes is pumped. These two holes are not unfrequently within twelve feet of each other and sometimes even closer. The contents of the filth hole or cesspool gradually soak away through the surrounding soil and mingle with the water below. As the contents of the water hole or well are pumped out, they are immediately replenished from the surrounding disgusting mixture."

When it is realized that such abominations exist in rural England to-day, we can afford to look with some toleration on the manifold defects of sanitation in India.

All shallow wells must be regarded as suspicious sources of supply, but in India their pollution is not as a rule due to drawing water from a filth hole as happens in the English garden but to pollution from the surface.

It is essential therefore that they should be properly made. The well should be lined throughout, or as far as down as possible, with porous brick. The upper portion should be steined. A small brick coping with a cover should be provided, and the area surrounding the well should be concreted and provided with a water channel.

Pumps should invariably be provided, as dipping of buckets provides almost endless facilities for contamination (*vide* plate opposite).

A radius of a hundred yards should, if military exigencies will permit, invariably be left clear around a well.

Artesian or tube wells are far better than dug wells. They consist of iron tubes hammered into the ground until water is reached. Like shallow wells, they must be ade-

quately protected at the surface to prevent pollution at that point.

Springs.—These are generally described as land and main springs. Land springs are often due to surface depressions touching the underground water level, *vide* illustration, page 37. Generally, when the underground water reaches its low level, such springs run dry.

Manifestly they receive their supply from very near the surface, and so are extremely liable to organic pollution.

Main springs are generally good, as they act as the main outlets for geological strata, but occasionally they are doubtful sources of supply and great care is necessary to investigate their immediate neighbourhood for surface-derived impurities.

So much for the sources of water. We must now consider how pollution may occur. This may take place—

1. At its source.
2. During storage.
3. During transit or distribution.

1. With reference to the fouling of sources of supply, it is obvious that every effort must be made, in peace time, to prevent any form of pollution in the catchment area. With regard to active service careful directions with reference to the protection of sources of supply are laid down in the Field Service Pocket Book, page 41.

Not only is the posting of sentries provided for in these regulations, but it is also laid down that patrolling of a stream by mounted men is often necessary to prevent pollution.

Instructions are given that when running water is not available, the supply is to be protected by a barbed wire fence.

2. There is no doubt that much pollution of water occurs during storage. It is very little use to boil water and then

leave it exposed to contamination of insects and dust. A comrade writes as follows:—"I recently inspected a camp and found the Larrymore boiler full of hot water and the lid wide open to hasten cooling as 600 men marched into camp, the dust forming a layer on the surface, in which one could have written the enteric history of the battalion."

Drinking water should not be stored at all in cold weather unless the procedure is absolutely unavoidable, but in the hot weather some simple means of storage *for the purpose of cooling* become an imperative necessity. A canvas bag with a tap and locked cover has much to recommend it. The ordinary Indian *surai* is not bad, but it has the disadvantages of being passed from mouth to mouth and it is not always kept covered. There is no doubt that this compulsory storage of water in barracks, for the purpose of cooling it during the hot weather, is a very fruitful source of pollution, and too much attention cannot be paid to it by the company officer and section commander.

Here again, is a matter where the regiment has to work out its own sanitary salvation.

No medical officer can do more than indicate the risk of pollution to which water is exposed to when stored.

It is for the regimental authorities to see that this source of danger to the soldier is avoided.

3. Pollution during transit is another very common source of infection.

A great deal of water is, and must be, distributed by hand in India, so here again is a matter which must demand the constant care and supervision especially of non-commissioned officers. It is hardly possible for officers to supervise details of distribution, but it comes well within the purview of section commanders.

We now come to a matter of the first importance, *viz.*, the purification of water.

In most tropical countries we have to start with the idea that water is bad, and endeavour to remedy the defects of the natural supply as best we can.

Broadly speaking there are three methods for rendering impure water innocuous :—

1. *Physical*—
   - (*a*) By distillation.
   - (*b*) By heat.
     - (1) Boiling in ordinary kettles.
     - (2) Special apparatus.
2. *Mechanical.*—Filtration.
3. *Chemical*—
   - (*a*) Mechanical.
   - (*b*) Germicidal.

1. *Physical.*—(*a*) Distillation is, of course, out of the question except on transports, but (*b*) boiling presents one of our oldest and best methods of preventing the noxious effects of bad water. Combined with some simple form of clarification or filtration, if fuel is available, it is the best method of dealing with water with which we are acquainted.

Its disadvantages are—

1. It is expensive because fuel is required.
2. The water becomes flat and insipid.
3. The water is heated and must be cooled before use.

The first of these disadvantages is vastly the most important. The remaining two can be got over by making the water into tea. Men will drink hot or lukewarm tea under most conditions, and apart from this the addition of a little tea has specific advantages.

Major McNaught found that *cold* tea killed the typhoid bacillus in about twenty hours, which is a point of the greatest practical importance.

Improvised filters employed by the Naval Brigade in China.

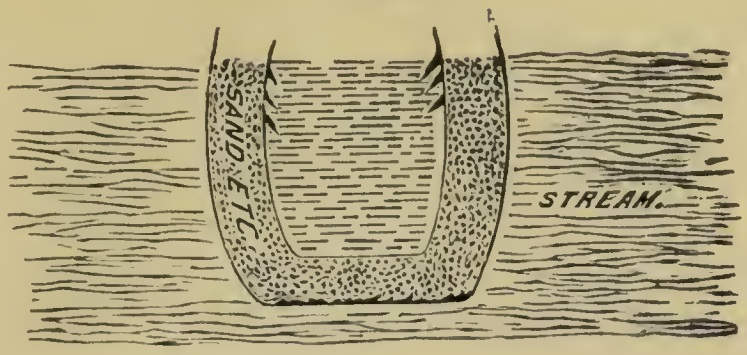


FIG. 3.

A

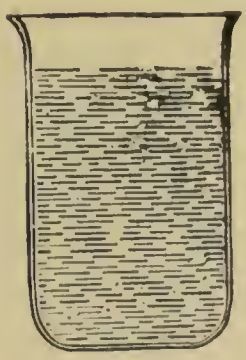


FIG. 4.

"Water was taken from the river and put into a large earthenware pot (A). Alum was added to clarify it. The clarified water was then decanted into B, which consisted of a small pot inside a large one, the small one having a hole punched in the bottom. The space between the pots was packed with sand, gravel, and vegetable charcoal, the water being poured into the interspace. A further filteration was carried on in another similar filter, and finally the filtered water was boiled."*

B

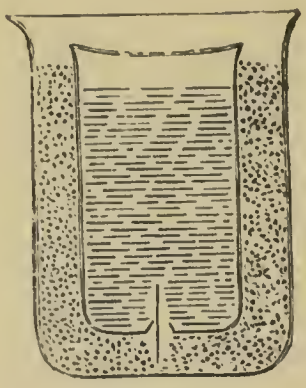
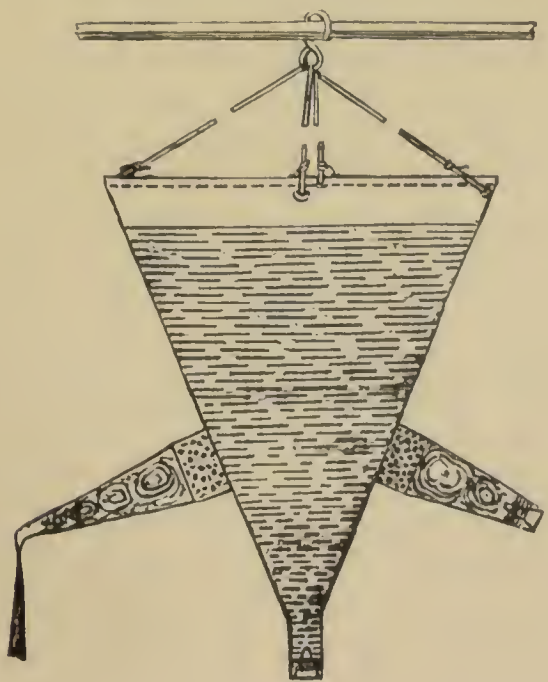


FIG. 5.

* Extract from a Paper read before the British Medical Association Meeting at Swansea 1903, by Fleet-Surgeon Lloyd Thomas, R. N.

Fig. 6.



"Ishiji" Camp Water-filter.

Special Apparatus.—A very large number of different varieties of special apparatus have been devised for sterilizing water by using a principle of heat exchange.

The heat of the sterilized water is utilized to raise the temperature of the incoming cold water as it passes on its way to the sterilizing chamber, whilst the cold, which the water parts with, is utilized for reducing the temperature of the sterilized water.

By this ingenious device water can be delivered at a temperature about 5° hotter than that which enters the apparatus. All this means a heavy and cumbersome apparatus, but the principle of these machines is undoubtedly sound, and it is more than likely that they may eventually prove a solution of one of our greatest sanitary problems in the field.

2. *Mechanical.*—Filtration of some kind or other is a method which is largely used. Filtration by sand and gravel is the one in use in civil communities and should not be forgotten for military purposes.

Even of the crudest nature, it improves the potability of a water, and a simple device such as two barrels fitted one inside the other with a good layer of gravel, sand, and wood ashes between them will not only clarify but actually purify water very considerably. (Figs 3, 4 and 5.)

The Japanese used a very simple kind of filter called the Ishiji filter. (See illustration Fig 6.)

It consisted of a canvas cone with two projecting arms fitted on to a collapsible metal ring.

The water was clarified by two special powders and passed through a block of charcoal, but in the absence of the powders and the charcoal, wood ashes or alum will do very well.

If special bags are not obtainable a clean blanket dusted with alum would act very similarly. Filters of the Berkfeldt type, with which every one in now familiar, are by no means perfect.

The candles require great attention and are liable to crack. It has been shown that typhoid bacilli will grow through them in four days, so they must be boiled every four days, a procedure which is difficult to arrange for in the field. Filters of this type are at present being tried by the Indian Government so they must still be regarded as in the experimental stage.

3. *Chemicals.*—(*a*) Alum, lime and permanganate of potash are used as mere mechanical purifiers, they have no specific action on water. They simply form a precipitate which falls to the bottom, carrying with it most of the microbes and organic impurities.

(*b*) Quite different are the various chemical tablets used as purifiers. They act by actually destroying the germs of disease.

Bisulphate of sodium is the best of these chemical purifiers, and is useful if allowed half an hour to act. The tablets are made up with saccharine and oil of lemon and form quite a palatable solution. The acid in these tablets will certainly destroy cholera germs very rapidly. For cavalry and during forced marches they constitute a useful resort as boiling and similar means of treating water must, under such circumstances, be out of the question.

The Water Bottle.—The soldier should be provided with a bottle in which he can boil his own drinking water. It ought to be a tea kettle rather than a bottle as tea has been shown to be so destructive to the typhoid germ.

The present type of bottle should certainly be discarded, as it has been shown by experiment that if infected by enteric bacilli half a dozen washings have failed to dislodge them.

Pending however the issue of a new pattern, the adoption of cold tea, as a regimental beverage on the march, seems a simple way out of the difficulty.

Water Discipline.—Lastly, we have the question of water discipline.

The rules in Combined Training and the Field Service Pocket Book are perfectly clear, but yet there have been lamentable instances of these being neglected in the most recent campaigns.

Unless self-control is taught and practised by units in the selection of their water supply, all sanitary organization in the field must fall to the ground.

There is no lack of training in fire discipline, and the subject is, of course, of supreme importance, but we venture to suggest that water discipline is not unworthy of consideration, as it has not unfrequently happened that neglect of sanitary precautions have had as serious effects in hampering the advance of an army as the lack of any of the other details, which *together with sanitation organization* make up the sum total which is called "military efficiency."

CHAPTER IV.

The Feeding of the Soldier.

Wherefore it appears to me necessary . . . . to strive to know . . . what man is in relation to the articles of food and drink.—Hippocrates, 460 B.C.

Frederick the Great is reputed to have said that "an army fights on its belly," and if this trite saying of one of the greatest of the world's captains be accepted as a maxim of war, it must be admitted that the question of feeding the soldier is one of supreme importance to every officer of the Army.

Indeed the relation between correct feeding and efficiency is so evident, that it appears certain that a more correct knowledge of the laws of diet in, not only, the barrack room but the officers' and sergeants' messes, would lead to improvement in the general health of the soldier, diminished invaliding, and greater economy in the upkeep of the great fighting machine of this country.

Let us first consider the soldier's diet generally.

The foodstuffs used by the soldier in various parts of the world are legion, but, as any detailed account of individual articles of diet is beyond the scope of this chapter, it will be sufficient to say that all the important constituents of them fall under one of the following five headings :

1. Nitrogenous compounds, including all varieties of meat, fish, flesh and fowl and also cheese.
2. Fats.
3. Carbohydrates, including sugar, starches, gums, and vegetables.
4. Salts.
5. Water.

The functions of nitrogenous foods are threefold—namely :

(*a*) To build up the tissues and repair the results of wear and tear in the body.

(*b*) To regulate oxidation.

(*c*) To be used as heat producers.

Fats are chiefly valuable as heat producers. They also develop visible movements and other forms of vital energy.

Carbohydrates act in a very similar way to fats, and to a certain extent they are interchangeable with them.

It is generally taught that in cold climates the fats should be increased, and in warm the carbohydrates, but Dr. Hutchison, the well known authority on food and dietetics, who has done the writer the honour of reading over the MS. of this chapter, disputes this statement, and considers that the amount of food of all varieties is much the same in all latitudes.

The salts necessary for the preservation of health are many.

Common salt is an imperative necessity of life and health. It supplies the soda necessary for salivary digestion and the chlorine for the hydrochloric acid of the gastric juice. Salts of the vegetable acids are essential in the soldier's dietary or scurvy will ensue, while phosphates are specially needful for the growing lads which from the bulk of our modern army.

Water to the extent of 2¼ to 4 pints daily is, of course, as we have seen in the last chapter, an absolute necessity of life.

The nutritive constituents of food, in accordance with their functions in the body, may, therefore, be classified as follows :

Tissue Formers.	Work and Heat Producers.
Proteids *i.e.*	Proteids and Albumens *i.e.*
Nitrogenous or fleshy foods.	Nitrogenous or fleshy foods of all kinds.
Mineral Substances.	Carbohydrates.
Water.	Fats.

The Soldier's Food in Barracks.

Our first consideration in dealing with the soldier's dietary must be the amount of food necessary to keep the body in health and vigour, and here we find ourselves confronted with the difficulty that it is by no means an easy matter to pronounce an opinion on the amount of any variety of food actually required by the living organism, as the accepted notions on the subject have been entirely upset within the past couple of years by the labours of an American physiologist named Chittenden.

This work has only been before the public for a comparatively short time, and is still, so to speak, *sub judice*, but is so important that it deserves to be carefully studied not only by medical officers but also by their regimental comrades, as the question of the amount of food necessary for the maintenance of health must interest every one, whether he be a leader of men or a simple citizen. Prior to Chittenden's research, diets had been drawn up by many learned hygienists as the results of their observations on the diets of people of many nationalities, but none of these authorities had definitely proved that the amounts so laboriously calculated were really necessary for the requirements of the body.

The Table No. II at end of book shows the typical working dietaries which were universally accepted up till 1905. The fourth column of this table may need a word of explanation. It will be observed that the fuel value of each diet is shown in "calories."

This is a convenient method used in expressing the value of diets which enables us, instead of saying we need so much proteids, starch and fat, to say we want so much heat.

The heat produced by the proteid, fat and so on, is a better indication of correct quantities than the actual amount of proteid or flesh-like material and fat used, because the value of these constituents to each individual body is different and the food materials also differ in quality.

The calorie, or heat standard, is the amount of heat required to raise 1 kilogram 1° Centigrade, or 1 lb. of water 4° Fahrenheit. When we thus express the potential energy of food we do not mean that all this energy takes the form of heat, but that *if it were* converted into heat a certain number of calories would be the result.

Professor Chittenden was induced to undertake his remarkable series of experiments by a Mr. Horace Fletcher, who for five years practised economy in diet associated with elaborate mastication. He was found at the end of this period to be able to perform the trying and arduous work of a university oarsman on a dietary possessing about 40 per cent. of the proteid or fleshy food, and not more than half the fuel value in calories of the standards fixed by most authorities, and yet to compare favourably in physique with individuals receiving double his amount of food.

Experiment showed that nitrogenous equilibrium was maintained, that is to say, the output of waste material from the body did not exceed the amount of various materials consumed, and that, therefore, his food was sufficient.

Dr. Anderson, the Director of the Yale Gymnasium, said :

> My conclusion, given in condensed form, is this : Mr. Fletcher performed his work with greater ease and with fewer noticeable bad results than any man of his age and condition I have ever worked with.

Chittenden, before describing his experiments in detail, points out that it is :

> Obviously of primary importance that we should know quite definitely what the minimal proteid requirements of the healthy man really are, and the experimental work to be detailed has aimed especially to determine whether it is possible to materially lower the amount of daily proteid food without detriment to the bodily health and with maintenance of physical and mental vigour.

Like most really keen investigators, Chittenden commenced by experimenting on himself, and started by reducing his proteids to one-third, and the fuel value of his food to one-half that given in the standard dietaries. He tells us that:

> At first the change to a smaller amount of daily food was attended with some discomfort, but this soon passed away, and the writer's interest in the subject was augmented by the discovery that he was unquestionably improved in physical condition. A rheumatic trouble in the knee-joint, which had persisted for a year and a half, and which only partially responded to treatment, entirely disappeared (it has never recurred since). Minor troubles, such as "sick headaches" and bilious attacks, no longer appeared periodically as before. There was greater appreciation of such food as was eaten; a keener appetite and a more acute taste seemed to be developed, with more liking for simple foods. Indeed the writer is disposed to maintain that he has done more work and led a more active life in every way during the period of this experiment, and with greater comfort and less fatigue than usual. His health has certainly been of the best during this period.

Chittenden's further experiments were conducted, with, of course, their own consent, on three groups of individuals, namely:—

1. Five professors and instructors of Yale University.
2. Eight undergraduates of the university who were all athletes in training.
3. Thirteen men of the Hospital Corps of the United States Army.

No restriction was placed on the articles of food consumed by these men, but the amount of flesh food was greatly decreased.

The experiments were of two varieties, namely :

1. Those in which the body weight was taken and the urine analysed for long periods of four, five, and six months.

2. Others in which the exact amount of nitrogen in the food and excreta was accurately estimated daily.

Speaking generally, the observations show that proteid food was reduced, from the ordinary standard of a daily allowance of about 5 ounces, to 1¼ to 2 ounces amongst the professional men, to 2¼ ounces (nearly) amongst the student athletes, and to 2 ounces amongst the soldiers.

Dr. Anderson, the expert in physical training above referred to, found the physical condition of the soldiers and athletes very satisfactory at the end of the period of dieting, Measured by strength tests it was actually found that the soldiers and athletes had gained greatly in strength.

Chittenden claims that the gain in strength of these athletes and soldiers cannot be assigned to systematic training. The only change in their mode of living which can in any sense be responsible for the improvement is the change in diet. The main fact to be emphasized is that these men—trained athletes accustomed to live on large amounts of meat in its various forms—for a period of five months reduced their intake of, not only red meat but all kinds of flesh food more than 50 per cent. without loss of bodily weight and with a marked improvement in muscular power.

To sum up briefly, Chittenden's experiments on several groups of individuals extending over some months tend to show that men may, without any increase of non-nitrogenous food, live in good health and gain in strength and activity on one-third to one-half the amount of the nitrogenous food usually considered essential. These facts are matters of supreme importance to military commanders, as in time of siege, or during expeditions, where the amount of proteid food is limited, a knowledge of these important experiments might enable the medical officers to suggest a

dietary which would economize the supplies available without any deterioration of the strength and activity of the troops.

We have dwelt at some length on these experiments, as the research work of Professor Chittenden is the most laborious, long-continued, and exact of any investigations into the dietary of healthy men which have been reported of recent years. His results have, however, been adversely criticized by Professor Halliburton and Dr. Robert Hutchison in England, by a brother professor in America, and by several other physiologists in various parts of the world.

The English critics propose to maintain the present standard of dietary, so as to have a reserve of proteid which may assist in enabling the organism to resist disease, and there is unquestionably much to be said in favor of their view, but a point of the utmost importance to us in India has recently been raised by Colonel Thompson, I.M.S., in a paper published in the *Journal of the R.A.M.C.* for October last.

Colonel Thompson regards the excessive incidence of enteric fever amongst troops in the tropics as due to the large increase in the quantity of fleshy foods in the dietary of the European soldier serving abroad as compared with the amount consumed at Home stations.

This view has not met with much support from officers of the R.A.M.C., but it certainly deserves consideration as having an indirect bearing on the work of Chittenden and others.

The matter is indeed one of supreme national importance, as, if it could be finally proved that the amount of meat estimated by Chittenden, and not that estimated by his predecessors, satisfies the physiological requirements of the soldier, our present ideas on the amount of food necessary will have to be rewritten, and most of the work which has hitherto been done on the subject will become almost valueless. From an economic point of view, the acceptance of Chittenden's new standards of dietary would of course

involve an enormous saving of public money, but the officer who introduces food reform of this nature is hardly likely to be popular.

Passing from the subject of the quantity of food required for the soldier, we come to the questions of the best methods of cooking it and of placing it before him in the most economical and attractive manner.

The object of cooking food is, as Hutchison points out, twofold :—

1. Æsthetic—to improve its appearance and to develop in it new flavors.

2. Hygienic—to sterilize it to some extent and to enable it to keep longer.

It is an error to suppose that cooking increases the digestibility of food. This is only true of vegetable food. The digestibility of meat is diminished by cooking although the increased attractiveness of cooked meat may render it indirectly more capable of digestion by calling forth a more profuse flow of digestive juices.

The processes of cooking employed are boiling, roasting, baking, stewing, broiling, and frying.

Boiling.—To retain the nutritious matters, the flesh in bulk is plunged into boiling water, and in a few minutes the external albuminous layer is coagulated. The temperature is then allowed to fall to about 160 degrees Fahrenheit, and the cooking continued. *To extract the nutritive matters*, the flesh is cut into small pieces, placed in cold water and gradually heated up ; if it is desired to extract the gelatine as for soups, it is heated to boiling point and kept simmering.

Roasting.—The same principle of coagulating the outside albumen applies to roasting, when the flesh is first placed close to an open fire, and then removed a little further away.

Baking is similar to roasting. As, however, it is carried out in a close oven the pleasant-smelling products, analogous to the caramel produced by burning sugar, which are developed by the action of heat on flesh are not formed to the same extent as in roasting.

Stewing is slow cooking with or without a little water; the temperature being kept well below boiling point. A simmering temperature is too hot for stewing. Simmering is only another word for boiling when, of course, the water reaches 212° Fahrenheit. In stewing the temperature should be only 180° or thereabouts.

Broiling is the term used when the process of roasting is carried out quickly on a gridiron.

Frying should mean boiling quickly and evenly in oil, instead of water.

The essence of frying consists in the sudden exposure of the food to a very high temperature.

The fish, or other substance, should be practically cooked throughout its substance almost instanteously.

It will be observed that this process differs entirely from so-called "frying," in which the fat is employed merely as a means of preventing the object from adhering to the surface of a shallow pan in which a sort of roasting is really accomplished. Full details of the various methods of cooking for soldiers are admirably detailed in the Manual of Military Cooking.

In the matter of service great improvements have taken place during the last few years in England, where the general mess or "so-called restaurant system" is now almost universal.

The waste under older methods of feeding, which are still in use in India is simply enormous, as an American military surgeon estimated that the value of waste in a single post of the United States Army was actually £200 per annum. Under the new scheme this waste is reduced to a minimum. There is economy in staff, cooking, fuel, and clerical labour, and as the result of the system the soldier lives nowadays in a simple form of club.

The writer had an opportunity of studying the working of the general mess in the 2nd Battalion of the Devonshire Regiment at Devonport, and, through the courtesy of the adjutant, is able to subjoin a copy of an actual week's dietary,

which speaks for itself (Table III). It will be seen that the food is excellently varied, and as the results of visits to the kitchen and dining halls it can be asserted confidently that it is well cooked and served in a manner superior to that of the restaurants which would be patronized by men of the station in life from which the soldiers of our country are usually recruited.

It is a great pity that this system cannot be introduced in India.

We do not see any real difficulties in the way and cannot but think that the great reduction in the number of cook-houses, which is a necessary corollary of the system, would in itself, be a sanitary improvement of the very first importance.

The Soldier's Food in the Field.—On reference to Table I the reader is at once struck by the fact that meat and bread, or biscuit, constitute the staple articles of nitrogenous diet of troops in the field in all the armies of Europe. With the single exception of occasional issues in South Africa, little or no attempt has been made to supply such cheap and excellent forms of food as cheese or oatmeal, although these articles would undoubtedly form excellent means of supplying a pleasant change from the everlasting "bully beef" and biscuits.

Cheese, indeed, does not receive the amount of consideration it deserves in military dietaries. It will be observed by a reference to Fig. 7 that it possesses higher fuel value than beef, yet it will be noticed that it finds no place in the diet table of the Devon Regiment, which may be taken as a type of the most recent dietary of the soldier in barracks. Dr. Newman says of cheese that :—

> It is much better as a food than beef, and weight for weight yields three times more calories than lean beef, and equal nourishment can be obtained from cheese as from beef at one-sixth the cost (*vide* Fig. 8). On the whole, cheese is one of the very best of all our common articles of food.

The cheaper cheeses, such as Canadian and Dutch, are often more nourishing than the expensive ones such as Gruyere, Stilton, and Gorgonzola, which are purchased chiefly for their flavour.

Oatmeal forms a part of the peace ration of the Russian soldier and of the service ration of the German. It is occasionally issued to the Austrian soldier in barracks, but is not in favour in any other European army. Hutchison describes it as the most nutritious of all cereals. It is very rich in fat so would be a useful addition to the soldier's ration in the field, which is notably deficient in this relation. Oats prepared by rolling instead of grinding and heated during the rolling process, are much more digestible and easily cooked than ordinary oatmeal. Prepared in this way the cereal constitutes the much advertised preparations of oats which, under various fancy names, are now so deservedly popular.

The value of sugar in the field ration of the soldier is another matter which is not appreciated as fully as it might be in Continental armies. Several French military surgeons have given special attention to the subject; and their evidence, from experience gathered in many experiments, suggests that sugar may replace a portion of the meat ration on field manœuvres or on service. One French writer goes so far as to suggest that the emergency ration should consist entirely of carbohydrate material, as it is generally accepted that this type of food is chiefly concerned in producing muscular energy. The dynamic properties of such food being superior to those of meat, a carbohydrate ration, might rightly claim the title of a fighting ration, or *vivre-de-combat*.

This contention rather upsets the popular British notion that the "roast beef of old England" is the foundation on which our solid British pluck is built.

Speaking of the *vivre-de-combat* invites our attention to the various concentrated foods which have been suggested and adopted in various campaigns to supply sudden emergencies from lack of supplies.

Notter and Firth say that of all such prepared foods, the army rations made by Moir, Maconochie and other makers appear best to conform to most requirements. "They exist in several varieties, consisting of mixtures of either beef or mutton, with potatoes, carrots, onions, beans, gravy and pickles. Some also contain bacon fat and brawn, the whole being cooked and contained in hermetically sealed tins of small size."

The present emergency ration recognises the importance of sugar as a food. It consists of a small tin weighing twelve ounces. It is divided into two compartments, one containing 4 ounces of concentrated beef extract and the other 4 ounces of cocoa paste. These preparations can be eaten as they are or can be made into 4 pints of soup and 4 pints of cocoa. The regulations proved that they must not be used without the orders of an officer except in great extremity. It is calculated that each ration will, unaided, keep a soldier going for 36 hours.

With troops in the field, where food is occasionally limited and frequently tough and uninteresting, it is especially important that officers and soldiers should be instructed in the importance of perfect mastication and insalivation of food. Sir Michael Foster, who made elaborate experiments on the subject, said: "The adoption of the habit of thorough insalivation of the food was found to have a remarkable and striking effect upon appetite, making this more discriminating, and leading to the choice of a more simple dietary, and in particular in reducing the craving for flesh food."

The appetite, too, is beyond all question fully satisfied with a dietary considerably less than with ordinary habits is demanded. Sir Michael Foster's experiments showed clearly that perfect mastication produces great economy in nutrition and a remarkable improvement in the condition of the whole gastro-intestinal tract. The waste products of the bowel were not only markedly reduced in amount, but actually became odourless and inoffensive. We think these

striking results of perfect mastication should be more widely known than they are. The teeth of the soldier are, of course, of first importance in this relation. We find that men in South Africa constantly complained of the effect of biscuit on their teeth ; and, indeed, the soldier who develops defective teeth during a campaign has before him "a long and dismal vista of intestinal troubles." Wherever possible, therefore, flour should be issued as a ration instead of biscuit, and bread made in field ovens. It will be found that, as soldiers are not expert bakers, it is preferable to issue baking powders for use in the field instead of yeast cake, which requires considerable skill for its proper manipulation.

Of necessity a large amount of the food of troops on service must be supplied in tins, and this brings us to a question which has attracted a vast amount of attention during the past few years. In view of the statements made by many persons well qualified to speak with authority there appears to be little room for doubt that the conditions under which animals were slaughtered, and tinned or canned foods prepared in America, were, and, possibly, still may be, filthy and disgusting, and that consequently grave dangers to health may ensue from their consumption. This danger may operate in one of two ways, namely :

1. Through food poisoning due to the filthy conditions under which the canning has been carried out, or
2. Through transmission of disease from the use of the flesh of animals which have suffered from tuberculous or other diseases.

Although it will generally be admitted that the tinned meat issued to troops is, ordinarily, of good quality, it is necessary, in view of the evils which are known to have existed, to endeavour to guard the soldier against any possibility of food poisoning or infection by tubercle or animal parasites through tinned food.

The instructions laid down for the examination of tinned foods in the Supply Handbook should therefore be followed

in no perfunctory spirit as it is impossible to expect the highest degree of efficiency from any machine unless the quality of the fuel supplied to it is of the best quality.

The orderly officer, or quarter-master, passing tinned foods should remember—

1.—To always look for the date stamp.

2.—If there is a faint suspicion of a drum-like note on tapping the tin, a suspicion not strong enough to warrant condemnation, put aside the tin in a warm place for twenty-four hours, and test again by tapping; if gas formation is going on the drum-like note will be more marked.

3. A most convenient way for testing of the presence of gas is to place a good-sized drop of water at one end of the tin, and to puncture the tin sharply through the drop; if there is a partial vacuum in the interior, the water will be sucked in; while if there is formation of gas, bubbles will escape, forming a froth with the water.

Every effort should be made to vary the rations of soldiers in the field, as monotony of diet produces a condition of gastric disorder which appears to predispose to enteric fever and dysentery.

We now come to the discussion of a question which is of the greatest importance,—namely, the advisability or otherwise of issuing alcohol to troops in the field. It must be understood that we hold no brief for total abstinence in a general sense but, our experiences at home and abroad convince us that alcohol in every form is best avoided by the private soldier.

We would like to especially call attention to the extremely common error that alcohol in any of its forms is a safeguard against cold.

It is nothing of the kind.

Instead of raising the temperature it produces an actual loss of body heat, so that the issue of "tots" of rum on cold nights is not only undesireable but actually pernicious.

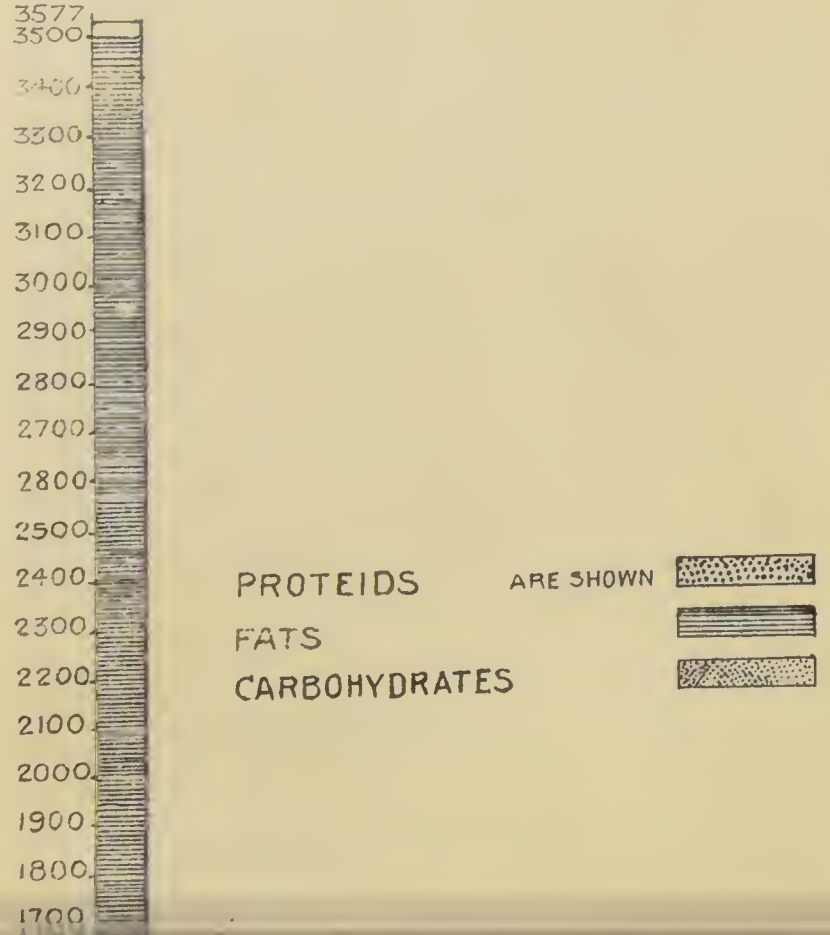
Parkes, who was the Father of the Science of Sanitation, speaks out on the subject with no uncertain voice. He says :

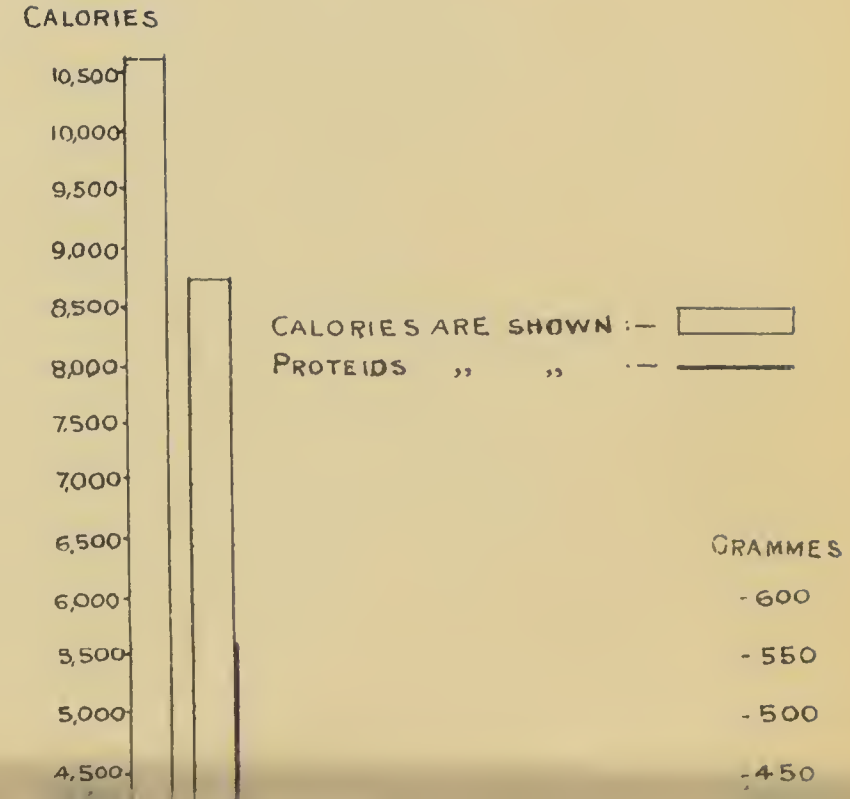
> When debarred from spirits and fermented liquors men are not only better, but far more cheerful, are less irritable, and endure better the hardships and perils of war. The courage and endurance of a drunkard are always lessened, but, in a degree far short of drunkenness, spirits lower, while temperance raises, the boldness and cheerfulness of spirit which a true soldier should possess. If spirits neither give strength nor sustain against disease, are not protective against cold and wet, and aggravate rather than mitigate the effects of heat—if their use, even in moderation, increases crime, injures discipline, and impairs hope and cheerfulness ; if the severest trials of war have not been merely borne, but most easily borne, without them ; if there is no evidence that they are protective against malaria and other diseases, then the medical officer will not be justified in sanctioning their issue, or their use, under any circumstances.

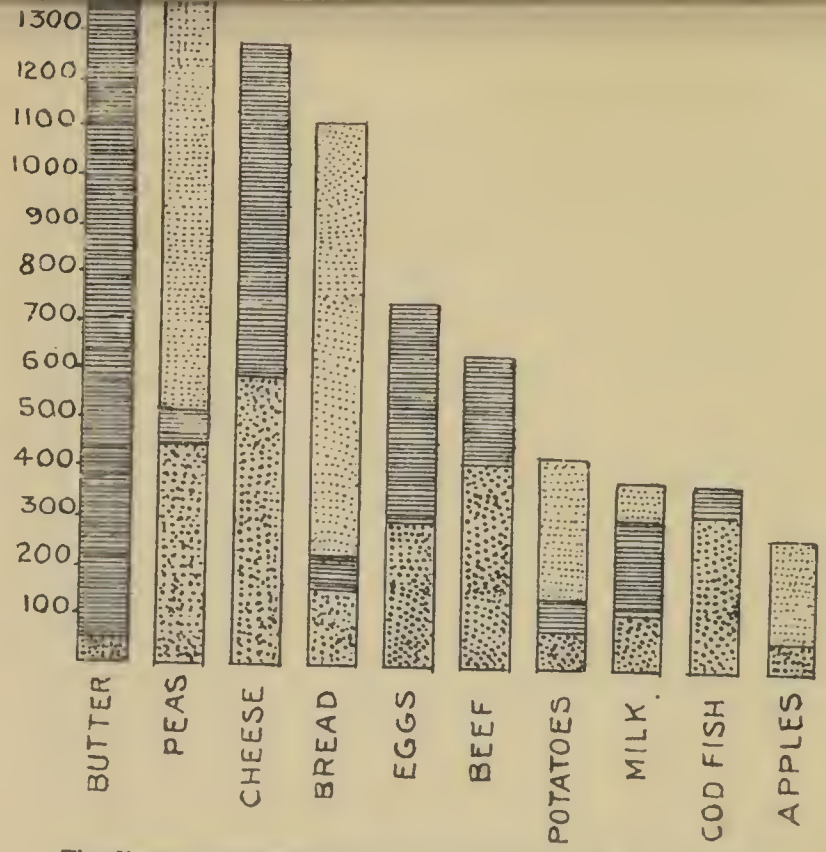
To this indictment of alcohol Munson adds his quota as follows :

> That there are rare emergencies in which alcohol might possess a certain value either to supplement an insufficient issue of food or gain a temporary stimulus at the expense of subsequent depression may, perhaps, be admitted. It is certain, however, that under nearly all conditions of military service alcohol in any of its forms is only pernicious to the soldier.

It is evident from the foregoing that we have the support of every military hygienist in condemning the issue of a spirit ration to troops in the field, except in some exceptional circumstances where, under the stress of war, it may be necessary to compel the soldier to draw an over-draft on the Bank of Life, well knowing that the action will render him physiologically bankrupt for some time to come.

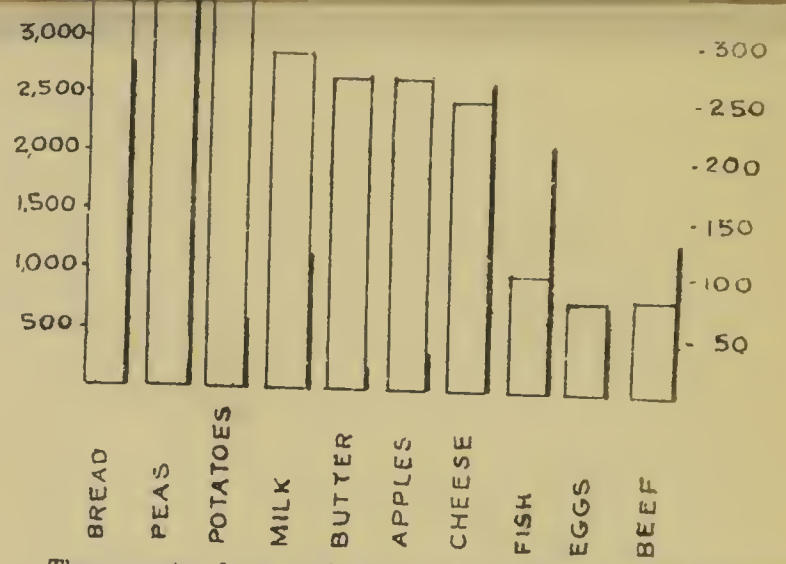

3577
3500
3400
3300
3200
3100
3000
2900
2800
2700
2800
2500
2400
2300
2200
2100
2000
1900
1800
1700
PROTEIDS ARE SHOWN
FATS
CARBOHYDRATES


CALORIES
10,500
10,000
9,500
9,000
8,500
8,000
7,500
7,000
6,500
6,000
5,500
5,000
4,500
CALORIES ARE SHOWN :—
PROTEIDS ,, ,, :—
GRAMMES
600
550
500
450



The diagram represents the relative number of calories obtained from each food, and also the relative proportions of proteids, fats, and carbohydrates. The total fuel value of a meal consisting of bread and cheese will be found to be nearly double that of one composed of beef and potatoes. Reproduced from the Author's paper in the *British Medical Journal*.

Fig. 7.



The amounts of energy (calories) and building material (grams of proteid) to be obtained for one shilling from some typical foods are graphically shown. The value of cheese as a cheap form of proteid food is well demonstrated. Reproduced from the Author's paper in the *British Medical Journal*.

Fig. 8.

Scurvy is a disease which merits a brief reference before closing this chapter. Like dysentery it has been from time immemorial the scourge of armies in the field. In the thirteenth century it ravaged the hosts of the Crusaders and from that time until comparatively recently it has almost continually, been present during military operations.

It is due to an ill-balanced dietary in which fresh meat and the salts of fresh vegetables are deficient.

The disease is entirely preventable and its existence is a reproach to the supply and sanitary services.

Failing the issue of fresh meat, fresh vegetables or fruit, one ounce of lime juice taken daily as a beverage is an efficient substitute. On reference to Table I it will be found that the British army is the only one in Europe in which provision is made for the routine issue of this preventative of scurvy to troops in the field.

CHAPTER V.

The Clothing of the Soldier.

Vast numbers of the British-born are continually moving southward, and when they do so their comfort, their health, and even the preservation of their lives largely depend upon the clothing they select.—Mattieu Williams in the Philosophy of Clothing.

When the army of Julius Cæsar landed in Britain some eighteen centuries ago the great general himself, informs us that the uniform of the British Army which opposed him consisted of colored mud.

It is usually supposed that this "uniform" was worn, like the dolman of the Hussars of our own time, merely for sake of ornament.

We think, however, that the practice originated with the simple and inevitable discovery that a layer of mud or clay, or, indeed, dirt of any kind, checked the cooling effect of free evaporation from the skin and thus the painting of the body served, very rudely and very unhealthily, one of the purposes of clothing. This "discovery" is not unknown in Britain to-day, when a layer of simple dirt often fulfils the function of the gaywoad of the ancient Briton.

It must be remembered that, up till the days of Napoleon, armies rarely if ever marched during the winter, so that Cæsar made his acquaintance with our Motherland in the summer time when such kit as the skins of animals was not likely to be "regimental." It is quite inconceivable that, even with the aid of much paint, the hardiest warrior of Britain could have withstood the rigours of our northern winter. The winter clothing of man in early times must have been largely the skins of animals, but if tradition speaks correctly vegetable material came early into use as the reader will remember that Eve made herself an apron, or petticoat, of fig leaves.

We still obtain all our clothing from a few animals, a single insect, a couple of small plants and several varieties of grass.

Animals yield us wool and leather ; the silkworm provides us with silk, whilst the cotton and flax plants and several grasses provide us with the remainder of our clothing materials.

Let us first, briefly, consider these different materials.

Wool.—Wool forms the natural covering of animals in cold and temperate climates.

It owes its value to the fact that it contains an oil or fat, and that, when woven into cloth, it has numerous interstices which imprison air and prevent heat passing through it.

The natural oil of the wool, which is now well-known as a toilet preparation, under the name of lanoline, is one of the most important constituents of flannel, but unfortunately bad washing frequently removes this natural grease and leaves the material practically worthless.

Woollen goods should be washed in water which is only just warm, and soap, which should be of very good quality, should be used sparingly. A little kerosine oil added to the water will remove gross dirt very quickly.

This fact is made use of by the manufacturers of a well known soap.

Flannel is a bad conductor of heat, and therefore it is not only warm in winter but cool in summer, hence the use of this material by Kipling's "fool at the wicket."

It should always be worn during the Indian cold weather and in the hills.

During the hot season its desirability, though frequently iterated, is doubtful.

Lieut.-Colonel A. R. Aldridge, Sanitary Officer at Army Head-quarters, writes: "It is not necessary that underclothing should be of pure wool. For hot climates it is difficult to get this either thin enough or soft enough to be comfortable, but various mixtures of wool and cotton, and

loosely woven cotton materials can be had which have these advantages, while being cool and soft."

Silk.—Next to wool silk is the best material for under wear, but its price renders it prohibitive for military purposes.

The soft and soothing feeling of a silken vest is due to the fact that silk fibres have a beautiful smooth surface.

They look like glass under the microscope and are readily distinguishable from wool fibres, which as wool is merely a variety of hair, present a rough surface.

Cotton.—Cotton has the great practical advantages of being hard, durable and cheap.

It is now introduced into most woollen materials to increase their durability and to prevent shrinking, and constitutes nearly a quarter of the soldier's flannel shirt.

In the form of various types of cellular clothing it is a capital material for hot weather wear, and even for use in cold climates these cellular materials have many medical advocates.

Specially woven and dressed it is very largely sold as "flannelette."

This material is cotton in its worst form.

It is not only undesirable as it soon loses its soft fluff and becomes as hard and unabsorbent as calico, but it is positively dangerous as it is highly inflammable.

A young officer of the artillery lost his life at Okehampton Camp quite recently through wearing a flannelette sleeping suit. A spark fell on the material which flamed up, like tinder, producing burns which proved fatal.

Linen.—Linen possesses no advantages over cotton as an article of clothing.

It can be woven into finer materials and takes a higher finish, so that its place in our wardrobes is an æsthetic rather than a hygienic one.

Leather.—Leather forms one of the most important materials for clothing the soldier.

It is an article which can be presented in an almost endless variety of qualities, but fortunately, the officer is not called on to select or judge the material for the soldier's boots.

The leather used in their manufacture, although country made, is however of good quality, and the boot itself is excellent of its kind.

India rubber, oil skin and waterproof.—Special waterproof fabrics have a very limited value in military service for protection from rain, and the only article of the kind in the private soldier's possession is his waterproof sheet. The principle of waterproofing ordinary materials has, however, a wide practical application in military life.

Munson recommends a three per cent solution of lanoline, or wool fat, in benzine as the best preparation for this purpose.

The process of waterproofing is very simple and can be carried out by any one even in the field. The clothing is merely immersed in the solution, the garment wrung out and the excess of solvent allowed to evaporate rapidly in the air.

About four pints of solution are required for the entire effects of a soldier.

Clothing impregnated with wool fat may be worn both in rain or sun without ill effects, permits the rapid evaporation of perspiration, and affords a better protection against rain than do fabrics waterproofed with alum preparations or other chemicals as recommended by some authorities.

The garments impregnated with wool fat are even more permeable to air than clothing not so treated, and are also less absorbent of watery vapour.

Moderate washing has no effect on the waterproofing of fabrics produced by lanoline, so the effects of the procedure are fairly permanent.

The expense is inconsiderable as the waterproofing of a complete uniform does not cost more than a rupee or so.

The inventor of the process, Captain Munson, sums up its advantages as follows :—

1. It waterproofs but permits free passage of air and water vapor.
2. It does not increase weight or alter the appearance, color, or odor of garments.
3. It increases the solidity and strength of the fabric.
4. It is cheap.
5. It is simple in application.

Let us now consider the various articles of the soldier's kit in some detail.

Boots.—Soldiers' boots are, as we have said, made of excellent leather in this country.

They are supplied in thirty-two sizes, and with a little pains it is possible to fit almost 99 per cent of a company really well.

Unfortunately the necessary pains are not always forthcoming as junior officers frequently fail to realize the relationship between the fit of their men's footgear and their military efficiency.

We would remind them that Napoleon is reported to have said that he made war not so much with the arms as with the legs of his soldiers, whilst Marshal Niel considered good shoes for his infantry as important as good mounts for his cavalry.

Saxe said that the whole of military tactics was in the legs of his soldiers, and our own greatest general, the Duke of Wellington, enumerated the three most important parts of a soldier's equipment as a pair of good shoes, a second pair of good shoes and a pair of half soles.

Munson says of all the protective articles which the soldier wears his shoes are by far the most important from a strategic standpoint; since upon their ease and the comfort of their fit, their pliancy and lightness, depends his military efficiency.

War is a business, and the soldier whose badly-shod feet are unable to carry him into battle fails of the purpose for which he was trained and instead of being an added strength to the fighting arm to which he belongs becomes simply an encumbrance.

One might quote in this relation that over thirty thousand German soldiers were incapacitated for duty during the first few weeks of the Franco-Prussian war on account of injuries of the feet clearly attributable to bad foot wear hardened by long storage in supply depôts.

Taking these facts into consideration we feel we are justified in commencing at the feet and moving upwards in our consideration of the clothing of the soldier.

Boots should be carefully fitted at all times, but require special consideration in India.

They should invariably be "tried on" over a thick pair of socks and may well be a size or two bigger than is actually necessary to allow for the swelling of the extremities which is associated with hot weather and for expansion of the foot in marching.

They must not be at all tight over the instep and great pains should be taken to see that there is plenty of room for the toes, especially the little one.

The soles should be pliable, as nothing is so tiring as walking with a pair of stiff soles on a long march.

Pointed toed "lady-killers" should be strongly discouraged by section commanders as they distort the natural shape of the foot.

New boots should be frequently used for "walking out" before being utilized for a long march.

Castor oil is one of the best things to rub into boots to render them soft and pliant and has no fault except that it is expensive.

In the French army a mixture of three parts of mutton tallow to seven parts of neats foot oil is employed.

The old soldier's trick of rubbing in bits of bacon fat is not a good one as boots thus treated soon acquire a bad smell

and attract flies in hot weather, whilst the rancid fat causes rotting of the thread with which the boots are sewn.

Dubbing, which is to be had in every coffee shop, is much better for marching boots than blacking, as it renders the leather more supple and more durable.

Some of the compounds sold as blacking are positively harmful as they contain small quantities of acid which, like rancid fat, rots the sewing thread and causes the leather to perish.

The boots of the cavalry arm of the service have points in their favour such as smart appearance and protection to the leg, but hygienically they must be unhesitatingly condemned as they are comfortable only for mounted use and very liable to chafe when walking.

If loose-fitting they afford no support to the ankle whilst if "snug fitting" they are difficult to get on and off. If the leather be wet or shrunken, the stocking damp, or the foot swollen—who has not experienced the pangs of torture which are required to deliver him from the thralldom of the jack-boot ?

Except for ceremonial purposes they have now been abandoned in favor of ankle boots with leggings or putties which must be regarded as a distinct hygienic advance.

Canvas shoes are still issued to British soldiers. They are a distinct luxury and when available should always be worn after a march, as it must be remembered that boots are, after all, merely leather bags which tend to soften or, as the soldiers say, "draw" the feet. Boots should therefore only be worn when their protection is required, and the feet "ventilated" whenever possible.

Socks.—The military stocking, says Munson, is an article which has not received the attention which its importance warrants. No stockings are issued in the Spanish, French and Italian Armies, a fact to which the frequency of foot injuries in these services must be largely attributed.

Three pairs are issued to the British soldier but this number is insufficient. He should have four pairs. Two at the

wash and two in use. They should be fitted as carefully as the boot, as if too large they go into creases and if too small they quickly go in holes.

A dirty sock has nearly as important a relationship to military efficiency as a dirty rifle !

It is hard and full of germs. It tends to blister the feet and the microbes which it contains readily infect the blisters and produce sore feet.

We, therefore, think that routine inspections of foot gear, generally, is almost as important as routine inspections of fire arms.

Certainly before entering on an expedition worn or darned stockings should invariably be eliminated from the soldier's kit, as, given the most perfect shoes, if a man has a hole in his sock his foot will invariably become blistered.

Darning might well form a subject for military instruction in barracks, as the rough and ready sock mending of the soldier in the field is very few degrees better than the holes it replaces.

During the Indian hot weather the thick woollen sock now issued is intolerable. It should be replaced by one made of merino for hot weather use. Socks of this material are comfortable, cool, and cheap.

Leggings and Putties.—Experience has shown that a well fitting legging is the best leg covering for cavalry, whilst the puttie forms an excellent protection for the lower extremities of the infantry soldier.

Like boots and socks these articles require careful attention from company and section commanders as a tight legging, or a carelessly applied puttie, not only spells misery to the individual wearing it but also military inefficiency, as a man can neither ride well nor walk far with the cramped leg muscles which undue pressure from an ill-fitting legging or puttie will assuredly induce.

Drawers.—These garments are not issued in India except to mounted units.

Every soldier should, however, provide himself with at least two pairs as they promote cleanliness and protect the abdomen from chills.

During the march trousers soon become filthy with dust and perspiration, and if drawers are not worn, they chafe and irritate the unprotected buttocks.

Trousers.—"Shorts" are now worn in most regiments and are excellent for marching, but it should be remembered that, especially if *jangiha* (or short drawers) are not worn they offer a ready means of access to a large area of skin for the wily mosquito.

All leg coverings should always be cut loose over the hips and thighs and supported by a pair of braces.

Belts should never be worn as they restrict the movements of the abdominal muscles, interfere with the action of the bowels and thus favour constipation.

A puttie wound tightly round the waist in the fashion which has become almost regimental in some corps is even more objectionable than the belt.

The Cholera Belt.—The official publication "Hints on the Preservation of Health in India" says very wisely that the flannel cummerbund generally fails to answer the purpose for which it is intended.

It is very difficult to keep in position and either rucks up under the ribs or lies in a roll above the hips.

In either case it is of little value as a protection and after exercise becomes converted into a wet poultice over the abdomen.

We would restrict the use of the belt to night wear when we consider it most useful as if a blanket is relied on in hot weather it often gets tossed off with resultant chill to the abdomen.

Chill in the tropics is undoubtedly a source of evil and it should be carefully explained to the young soldier that, whereas chill in temperate climates usually results in nothing more serious than a cold in the head, in hot

countries it produces lessened vitality of the abdominal contents with *at the least* a "go" of diarrhœa or "liver," and *at the worst* an attack of dysentery..

It is therefore a thing to be carefully guarded against in every way.

The Shirt.—The soldier's flannel shirt is an excellent garment but is liable to produce prickly heat if worn in very hot weather.

Bannians, or undervests, of some cellular cloth are cheap and should be used underneath it during extreme heat but the shirt itself should never be replaced by the flannelette rubbish which finds such a ready sale to soldiers in some Indian bazaars.

The shirt worn during the day should never be worn at night.

We have previously shown that the skin is an excretory organ and when it is realized that a man taking violent exercise may throw off four pounds of perspiration in an hour it is obviously undesirable that he should allow the excrementitious material thrown off during the day to be soaked up again by the skin during the night.

The wise soldier will, therefore, provide himself with pyjamas or night shirts.

Made of a material, such as Cawnpore twill lining, these garments can be procured in any Indian bazaar at a cost which is by no means prohibitive.

Coats.—The tunic has little to recommend it except its smart appearance.

As it is now only worn for ceremonial, its defects are not material.

The service jacket should be as loose as possible.

There is a tendency to make it as like an ordinary mufti jacket as military requirements will permit.

Worn with a soft collar or necktie the khaki jacket worn in India fulfils most sanitary requirements.

It has been suggested that the khaki drill issued to troops might be replaced by khaki flannel, but we are inclined to think that the "Coat British warm" is all that is necessary.

If promptly donned at sunset it unquestionably will prevent chill so that the necessity for the enormous cost involved by issues of flannel clothing, as advocated by some writers, is not obvious.

Helmets.—The pattern now issued to troops in India is light, durable, and comfortable.

It weighs thirteen ounces and gives a good protection from the sun.

Its efficiency might be augmented by lining the interior with orange coloured flannel. (*See* Sunstroke, chapter IX, p. 119.)

The importance of wearing the helmet during the briefest exposure to the sun's rays should be emphasized by section commanders as men frequently run about between their barrack rooms with bare heads even in the hottest weather.

Equipment.—Napoleon believed in reducing the equipment as far as possible but named the musket, cartridges, four days' rations, and the pioneers' tools as five things which should never be separated from the soldier.

A spare shirt, an extra pair of shoes, and a kerchief he considered desirable but not essential.

This scale would hardly come up to modern requirements although the tendency of recent years has been to reduce the load carried by the infantry soldier.

The personal kit and equipment of the soldier in the field is laid down in Army Order No. 71 of April 1904.

The equipment detailed in this order which includes the rifle, 100 rounds of ammunition, clasp knife and all other articles, including one pair of drawers, weighs 50 lbs. 7¼ oz.

A recent committee recommends that the soldier should carry an additional load of 2 lbs. 1½ oz. made up by an additional shirt, bootlaces, towel, soap and pay book.

It is very important that this load of nearly four stone should be carefully adjusted so as to avoid any tendency to lean the body backwards or forwards as must become necessary in carrying badly balanced weights.

Any strained position inevitably results in needless fatigue and consequent diminished efficiency.

The present equipment lends itself to ready adjustment but an adaptation of the "Rucksack" so familiar to the Alpine climber, has been recently tried and has much to recommend it.

It is carried by broad webbing straps and hangs well down on the small of the back.

The sack carries everything except ammunition and water-bottle and provides space for spare articles acquired on the march.

The straps do not cross over the chest so that the coat can be thrown open on the march—in the writer's opinion a very important detail—but the great advantage of this type of equipment is that it can be removed in a few seconds leaving the soldier free from all impedimenta when going into action at the double.

CHAPTER VI.

The Housing of the Soldier.

Houses are built to live in and not to look on; therefore let use be preferred before uniformity, except where both may be had.—Lord Bacon.

At all times the greatest care is necessary to counteract the injurious effects of compressing a number of persons into a restricted space and in consequence as Notter and Firth have pointed out "barracks in our army *have been*, and in many armies of Europe still are, a fertile source of illness and loss of service."

In these days when flats have become so popular one is apt to overlook the fact that there is any real danger in the mere fact of living in barracks as the huge buildings in which so many Londoners spend their lives are little else than luxurious barracks.

It should however be realized that there is a distinct danger in the concentration of inhabitants under a common roof as statisticians have clearly shown that the amount of airborne disease increases directly with the number of persons accommodated on each acre of ground. We have long been accustomed to hear that our chief sanitary necessity in this world is pure water. This would be quite true if we were fish.

But it is obvious that the purity of the air we breathe is of far greater importance than the purity of the water we drink, seeing that we must take a draught of air about twenty times a minute, while many of us do not take a draught of raw water from week's end to week's end.

If the huge death rate of the Strand district of London were due to impure water we may be sure that there would be no lack of discussion thereupon; but as it is due to overcrowding, and the filthiness of air consequent upon overcrowding we hear nothing about it. (Rural Hygiene, p. 80.)

Cleanliness is said to be next to godliness but from a military point of view it is next to no other quality but *the* supreme military necessity as cleanliness of barracks and their environment generally is absolutely essential to the efficiency of an army in peace or war.

Modern barracks are constructed so as to facilitate the preservation of cleanliness with the least possible expenditure of labor. Old barracks on the contrary are rarely so devised but nevertheless they are frequently far from being insanitary and can often be rendered just as healthy as the most modern if sufficient care and attention is devoted to them.

The bad workman quarrels with his tools but the skilled and experienced craftsman makes the most of those appliances and materials which come first to his hand.

It is not to be expected that Government will pull down all old barracks on account of sanitary defects as the purse of the State though wide is limited and it is our duty as practical sanitarians to adopt and utilize these old buildings so that the health of the troops that occupy them shall not suffer.

Unfortunately all units do not fall under the heading of skilled craftsmen in the supervision of the barracks under their care for here again it must be insisted upon that every individual soldier is an executive sanitarian and unless the officers and non-commissioned officers instruct their men in sanitary measures the best efforts of the Medical Officer must go for naught.

The first and most important matter to consider in relation to the environment of the soldier is:—

The Barrack Room.—We have endeavoured to show the necessity for fresh air in Chapter II, but must here again call attention to the frequent neglect of this primary necessity in the barrack room.

Disregard of this important sanitary requirement is due to three things, *viz*:—

1. Ignorance of sanitary necessity.
2. Prejudice against so-called draughts.
3. Carelessness on the part of section commanders.

The first of these causes we are endeavouring to remedy in the Army by educating officers and non-commissioned officers in the principles of sanitation.

The last is a matter for the regimental authority whilst the second as we have endeavoured to show in Chapter II is largely a matter of prejudice.

The air space provided for the soldier in an Indian barrack room in the plains is not illiberal.

He is allowed 90 square feet of floor space and a total area of 1440 cubic feet.

In the hills he is allowed 60 square feet of floor space and the same air space as at home stations, namely 600 cubic feet.

Windows are provided at the rate of 1 to 2, and doors in the proportion of 1 to 5 occupants.

The interiors of the rooms are whitewashed twice yearly whilst every four years color-washing and painting of woodwork is authorized.

The cleansing of barrack rooms should be carefully supervised.

A familiar procedure is to swill them out with a large quantity of water mopping up the excess. The best plan is to have the barrack room scrubbed in the same way that the sailor or marine cleans the deck of his ship.

In most Indian stations the difficulty experienced at home and colonial stations with regard to barrack room floors is not felt—at least in the plains—as most barracks are only one-storied and stone floored. but in hill stations, where barracks are very similar to those in temperate climates, this difficulty with regard to the floors arises.

Water from scrubbing passes through the joints of the boards and accumulates, in the case of a lower storey, between the floor and the ground, and, in the case of an upper storey, between the floor and the ceiling of the lower storey.

Here it mixes with the dust and microbes which accumulate in this position, and as moisture, darkness and warmth

constitute the essential requirements for the growth of germs the space below the floors soon becomes highly insanitary.

Who has not experienced the unpleasant smell of a newly scrubbed barrack room on a day in winter or in "the rains" when a big fire is blazing up the chimney and the doors and windows are closed ?

The dampness and general unhealthy condition of the barrack room under these conditions fosters rheumatism and induces the epidemics of "barrack-room sore throat" with which all officers and section commanders are familiar.

Cupboards in barrack rooms require constant supervision. If the tops are flat they should be arranged so as to make them sloping as we must aim at preventing any accumulation of food or refuse which might provide a breeding ground for flies.

All articles in a barrack room should not only be moveable but frequently moved.

Bed cots should be cleaned regularly and exposed to the sunlight frequently. Bugs are frequently found in them on arrival at hill stations and are best got rid of by kerosine whilst powdered Dalmatian Flowers are destructive to fleas, which are also unpleasantly common in this country. We refer in further detail to the question of insecticides in the chapter on disinfection (page 101).

Mattresses should be freely exposed to the sun and air at frequent intervals. Colonel Firth very aptly enquires "How many officers realize that from 6 to 10 per cent of men wet their bedding at least once a month ? Yet such is the case."

Towels should be dried on a rail and not over, *and into*, the bedding, as is at present only too customary.

Ablution Rooms.—Men should be taught to leave their basins clean behind them, but the preferable plan is to provide each man with a basin for individual use.

The floor should be of some impermeable material and well sloped towards an efficient drain.

Waste water should be received in metal receptacles which are emptied daily or conveyed by *pukka* drains to cultivated land or the roots of trees. These drains should be carefully swept out morning and evening, but even with daily attention soapy water is apt to clog the channels and become offensive.

This can be prevented by filtering the waste water through some dry grass as suggested under the heading of kitchens.

Bath Rooms.—Eight bath rooms per company are usually provided in plain stations, but only half that number in the hills.

Lelean suggests that the use of shower baths of hot water would be an excellent measure, as it saves eighty per cent. on the amount required for immersion baths, and the space required is only about two-thirds that necessary for ordinary baths. If this device were adopted the amount of fuel supplied would permit of every man getting a hot bath daily, a great desideratum during the hot season.

Dining Rooms.—The adoption of the restaurant system with its necessary corollary of dining rooms is much to be desired in India.

Social reformers have preached about the "soul-destroying influence of the one-roomed home," and it is obviously insanitary that the soldier should eat, sleep and clean his kit in one room even when, as in India, it has a verandah which is, not infrequently, a dining room by day and a urinal by night.

The advantages of the dining hall system are fourfold, *viz.*

1. The barrack rooms are better ventilated as they are, at least, vacant at meal hours.

2. They are cleaner as there is no food lying about to foster flies and encourage the presence of rats and other vermin.

3. The dining hall means fewer kitchens, fewer natives to supervise, and fewer cooking pots to keep clean. Under existing conditions an Indian barrack simply swarms with kitchens, each a source of potential danger to the soldier

The whole cooking of a battalion could easily be done in two large central kitchens.

These kitchens could be more elaborately equipped and more efficiently looked after than the dozen small ones now in use, and there would be greater variety in diet, less waste, better cooking, and last, but not least, better carving, as with the restaurant system men can be specially trained as carvers.

4. Lastly, the dining room of the restaurant system with its clean tablecloths, special crockery, and, in some units even flowers on the tables undoubtedly tends to engender recruiting from a higher social stratum and also to foster a feeling of self-respect amongst the men.

The dining rooms should be near ablution rooms and all units should have a regimental order that men must wash their hands before sitting down to a meal.

There should also be an order in each corps that no man is to be employed in the handling of any food supplies unless certified medically fit. This order is, of course, intended to exclude "carriers" of intestinal disease.

Kitchens.—These are undoubtedly the most important place in the barracks.

The floors should be of impermeable material and well sloped to facilitate flushing. The windows should be covered with fly-proof gauze and self-closing fly-proof doors and fly-proof cupboards provided if possible.

Every effort in fact should be made to exclude the fly, which is a well-known carrier of disease.

Waste water should be passed through a grease trap before being discharged into drains. A very simple and efficient trap is formed by piercing holes in the bottom of a kerosine oil tin and filling it loosely with grass which has been soaked in crude petroleum.

The grease becomes congealed and entangled in the grass which can be burned in an incinerator daily.

The crude petroleum keeps off flies, and converts the grease-soaked grass into a material which will burn fairly readily.

Cooks should wear a distinctive dress and be provided with a dressing room outside the kitchen.

A simple code of rules such as the following should be hung up in every kitchen and enforced as Regimental Orders.

Rules for Cookhouses, ... Regiment.

1. Every person employed in the cookhouse will wash his hands on entering the kitchen.

2. The master cook will be responsible that special clothing is invariably worn by all persons.

3. Floors will be flushed out daily with hot water and scrubbed with hot water and soap at least once weekly.

4. Sinks and pipes will be flushed with strong soda solution made by adding two ounces of washing soda to a quart of boiling water at least once weekly.

5. Jharrans will be given to each cook by the non-commissioned officer in charge daily. They will invariably be washed, and stored, under European supervision.

6. All refuse bins must be kept covered and emptied daily.

7. The non-commissioned officer in charge will see that *mutti* is not used for cleaning cooking vessels. Bathbrick is provided for the purpose.

8. The Jemadar will be responsible that any case of illness amongst the native cooks, or their families, is promptly reported.

9. Chopping blocks will be scraped daily.

10. All milk will be boiled on receipt and kept in a covered receptacle till required.

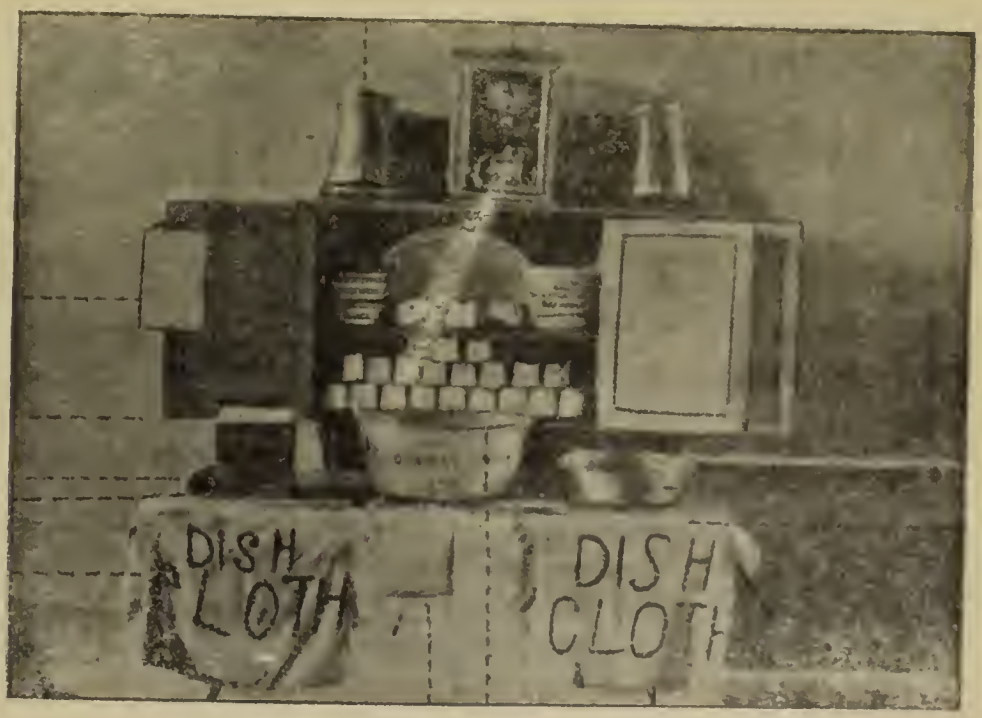
11. Sweepers are not to be allowed to enter the kitchen.

12. The orderly officer will see that all cooking utensils are properly cleaned and put away after the evening meal.

There should be a definite arrangement for washing up in all regimental cookhouses.

Major Erskine points out that the following method is in use at Cairo by all troops in the command.

"The permanent sanitary orderly of each company, squadron, section, &c., is given a board of orders for washing up, signed by the adjutant. They are regimental orders, and learned up and carried out accordingly. These men are



1, Board of Orders ; 2, soldier's sheet new from quartermaster's store, and cut into required lengths ; 3, empty "sanitary powder" tin, refilled with bath-brick powder, fresh scraped from the brick ; 4, biscuit box obtained from grocery bar, stripped of its paper covering and polished holds all the dry cleaning articles ; 5, soldiers towel from quartermaster's store, stencilled "Dishcloth" in large letter with marking ink, and used for drying dishes ; 6, sponge cloth used for cleaning guns, obtained from quartermaster's store ; 7 dish bath (all baths for washing floors mops, and suchlike, are arranged at the other end of the room) ; 8, ration tin ; 9, tea cans ; 10, butterdishes in box with wire gauze door ; 11, six-foot trestle table.

never taken away from their sanitary work for any other duties, except absolutely necessary military ones such as a course of musketry, which they must attend to keep efficient as soldiers. On these occasions their places are filled by

men approved of by the medical officer, and instructed by him. The Order Board read as follows :—

Instructions for the Sanitary Orderly Superintending the Washing-up of Dishes after Meals.

(1) All cans, meat dishes, plates, mugs, knives and forks, bath tins, and other utensils used at meal-times, should be scoured or cleaned on the *scullery table* of the company on the verandah or in the barrack-room, and *not* placed on the floor or taken to outside taps.

(2) One bath, marked "Dishes," and one ration-tin should be used in the washing-up of such utensils. They should be filled with boiled water from the cookhouse. After a meal the utensils should be first washed in the bath and then passed through the water of the ration tin containing half a teaspoonful of permanganate of potash dissolved in it.

(3) Washing baths for dishes should on no account be used for other purposes.

(4) Clean *sponge cloths* only, should be employed for washing utensils in the bath, and they should be well washed in clean water before drying. These sponge cloths with the *drying cloths*, should be hung to dry on the scullery table.

(5) Only *clean bath brick*, shaken from a tin (coffee tin with perforated lid or suchlike,) should be used for scouring tea cans, meat dishes, and knives and forks.

(6) The sanitary orderly of the company, under the non-commissioned officer of the room, should superintend the washing-up after every meal and be responsible to him.

The reason for having a scullery table is, that everything used by the men at their meals and for carrying their food to them, should be cleaned by cleanly means on a table and away from the floor or the ground.

The scullery table should have a sink with hot and cold water near it. Any lack of the needful, including boiled

water from the cookhouse, is to be at once reported by the orderly.

Anyone who has watched the usual washing-up after meals in barracks abroad, may have seen old shirts used as dishcloths, lying in the tap-water in the bath used for washing floors, or "good" work done with some bath brick scraped near a night urinal stand or with sand collected outside the barrack-room verandah by the ever-changing orderly-man or "swab" of the day.

The scullery tables should be inspected daily."

Refuse Bins.—These are favourite breedings places for flies.

They should be kept as far as possible from the kitchen and, as above suggested, cleaned out at least once, and preferably, twice daily.

Latrines.—Next to the cookhouse the latrine is the most important portion of barracks.

In the first place it is essential that in India it must be at least 100 yards from any cookhouse. The reason for this is that three per cent of all men who have had enteric fever are what are called "carriers" (*vide Supra* p. 7).

They pass at irregular intervals typhoid bacilli in large quantities in their stools or urine. With a dry system of conservancy and the agency of flies these bacilli may readily be conveyed to food causing the small epidemics which have so frequently puzzled commanding officers and sanitarians in past years.

Latrines should be provided with sloped and impermeable floors. It has been decided by Government that all existing latrines will be provided with floors of this nature as funds become available. Pending reconstruction all earthern floors should be sprinkled with a disinfectant daily. Cresol is best for this purpose. If a fine sprinkler is used the cost will be trifling.

Where possible the so-called dry earth system should be replaced by what is known as the "wet system."

This consists in the reception of the excreta in a weak disinfectant solution made up by adding an ounce of saponified cresol to a gallon of water.

This disinfectant solution has a threefold effect, *viz.*:—

1. It acts as a deodorant.
2. It deters the access of flies and acts as an insecticide.
3. It depresses the vitality of sewage bacteria and may even destroy them.

Of the benefit of this system as far as we have gone all are agreed, but the crux is how to dispose of the excreta mixed, and diluted, as it now is with a disinfectant.

Three systems are available :—

1. Incineration.
2. Sterilization and burial.
3. Trenching.

1. *Incineration.*—In the far north of India latrines are being grouped with an incinerator as an annexe to each. The excreta are disposed of directly on to the incinerator, and receptacle and Crowly cart—familiarly known as "ironclad"—are both dispensed with. The incinerator in use is Raite's pattern, made of hoop iron. It is started with stable litter and kept going with leaves and refuse. The practical difficulty with this method is the disposal of fluids. It is obvious that liquid excreta are largely in excess of solids and that the trouble of burning large quantities of urine plus weak disinfectant solutions must present so much additional labor to the sweeper that not infrequently he tips the fluid ordure into a neighbouring drain or irrigation channel. This is a serious drawback and it should be realized that, although the system is most attractive and will probably eventually solve our difficulty, under existing conditions it possesses grave difficulties in practical working.

2. The treatment of sewage by heat so as to render its harmless has been advocated and in this relation Glen Allen's Excreta Sterilizer, described in the November number of the *Journal of the R. A. M. C.*

for 1907, is worthy of consideration but this plan has yet to be tried on a municipal scale.

3. Shallow trenching, on either the Allahabad or Thornhill pattern is in use in every cantonment in India.

The main objections to this method have been demonstrated by Colonel Glen Allen.

He points out that it is dangerous to attempt to make a conservancy system a successful commercial enterprise as safety is likely to be sacrificed for the sake of profit. Moreover, it is a mistake to rely upon an agent, the physical conditions of which are liable to such great variations as the soil, to convert the dangerous sewage of a hospital or barracks into harmless and valuable manure.

Sewage should, therefore, it is contended, be committed to the soil either previously sterilized or in such a fashion as to avoid all possibility of spreading disease. "To do otherwise is to lean for safety on the broken reed of chance instead of the iron staff of science."

As a matter of fact the drawbacks to trenching are its great cost and the difficulties of providing supervision. The "Iron-clads" are only dangerous if they are not looked after.

Whatever method is adopted let it be done in the daylight when adequate supervision is possible. The absurdity of attempting to carry out any system of treatment, or removal, in the dark as has hitherto been the custom in India must be apparent on the briefest consideration.

Latrine seats require very careful supervision in barracks as only too frequently they become fouled, and the most careful treatment of pans is vitiated by fouled seats which are rapidly discovered and visited by flies.

The seats should therefore be soaked with crude kerosine oil weekly and wiped with strong cresol solution at least once daily. Another reason for carefully wiping the seats with a disinfectant is referred to in Chapter X.

Refuse Disposal.—Whatever diversity of opinion may exist with reference to sewage there can be no two opinions on

refuse disposal. Burning is the only sanitary method for disposing of barrack, kitchen and stable refuse. This being the case we have an argument in favour of the introduction of incineration for other waste material which has deservedly been given much prominence.

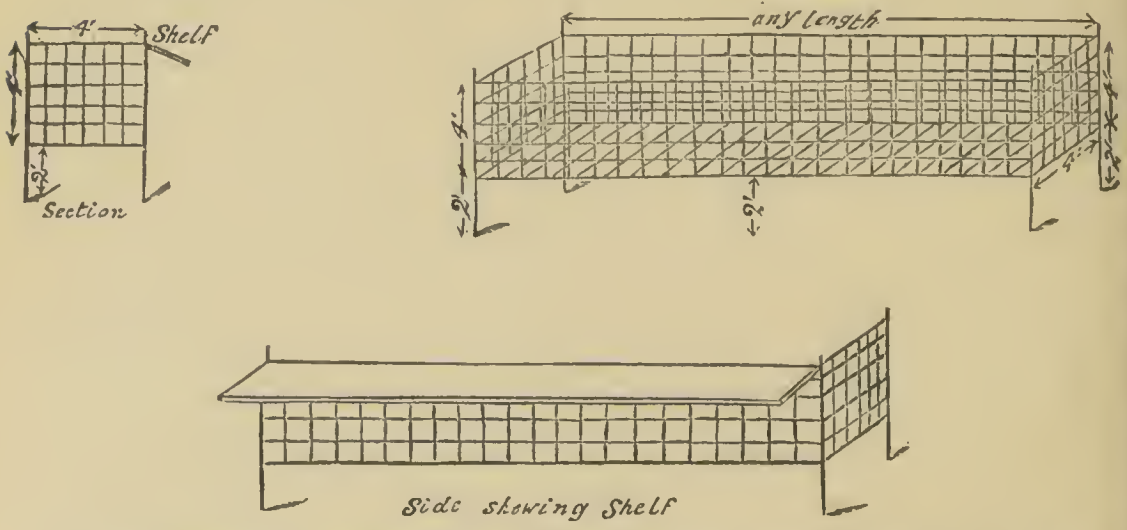
Stable litter is a material which is of great sanitary importance as it forms *the* favourite breeding ground for flies. It should not be deposited within 600 yards of living rooms unless it is removed daily.

In India it is generally taken over by the grass farms managers, or sold to contractors, but it must not be used as a top dressing in cantonments without the authority of the cantonment committee.

In many places its disposal is a matter of difficulty. It can always be got rid of where incinerators have been installed but in other places the following simple type of destructor fulfills all requirements. It was devised at Harrismith by Conductor Tompkins and Major Clark claims for it the following advantages :—

(1) Simplicity and cheapness.
(2) Rapidity of action– especially in wet weather.
(3) Manure may be loaded directly into it.

"The apparatus may be described as a large trough made



of wire-work, raised two feet above the ground. The trough may be of any length, but should be 4 feet wide and

deep. It should be broadside on to the prevailing wind, and the bars forming the bottom of it ought to run from side to side and not lengthwise. The mesh must be about 5 inches square, and a "shelf" of corrugated iron or other material about a foot wide should be fastened along the top to reduce spillage while the litter is being transferred from cart to destructor. The waggon to be unloaded is backed right up to the incinerator; and the litter is set alight in the ordinary way, near the bottom."

Urinals.—Much that has been said about latrines might be repeated with reference to urinals. The metal troughs which are still in use at most stations should be replaced by earthernware, and flies kept off by smearing the trough with crude kerosine oil daily.

Receptacles should, where incineration is the method of disposal of sewage, be filled with sawdust which has a remarkable power of absorbing urine. At hill stations pine needles can be used instead of sawdust. The sawdust or pine needles should be burnt as frequently as possible.

This method has been used with success in the public latrines at Peshawar for some months.

Each urinal should be provided with a good lamp; and it should be the duty of the barrack orderly sergeant to see that these lamps are lit nightly. Urine tubs for night use require careful supervision.

Only too frequently they are placed in an unlighted verandah.

The condition of the verandah in the morning and the risk involved as each bungalow may contain a "typhoid carrier" can be better imagined than described. Urinals and latrines adjoining canteens, coffee shops and other institutes require special attention as they are not only largely used but adjoining to large supplies of food.

Regimental Institutions.—The institutes of a regiment, especially when these are in the hands of native contractors, require constant European supervision.

The storage of food and mineral waters is often faulty, whilst the cooking arrangements are not infrequently far below the standard of the company kitchens.

Regimental bakeries should be in charge of an officer who should see that all the rules laid down for kitchens are observed. Facilities for washing the hands of the bakers should be provided and their use enforced under European supervision.

Flour should be stored in metal receptacles and no natives should live in or near the bakery or indeed any regimental institute. Marble or slate slabs for pastry making and facilities for grinding salt are essential articles of equipment

Dairies are now rapidly passing from regimental hands into the control of a Government department.

They are very undesirable in regimental lines as cowdung is in high favour with the common fly as a depository for her eggs.

Where regimental dairies still exist the rules for kitchens should be strictly observed. Cows must be fed, milked, and groomed under European supervision and all milk should be pasteurized.

The milker's hands should be as carefully washed as the cook's, and the cows' udders and milk cans given as much attention as the cooking pots.

Mineral water factories are a source of comfort to the men and profit to regimental funds.

Every step of the process of manufacture must be carefully supervised by a *trained* non-commissioned officer, as it must be understood that the addition of carbonic acid does not render a polluted water harmless.

The instructions of the regimental medical officers should be taken with reference to the treatment of water.

If filters are used the candles must be boiled every four days.

The cleaning of bottles is a matter of the greatest importance.

Who has not seen the sepoy of a native band drinking soda water at a station club, or the chokrahs on a golf links consuming *mitha pani* direct from the bottle ?

It is not pleasant to think that these same bottles, very carelessly washed, may be at the mess table a day or two later.

All bottles should be carefully soaked in strong permanganate of potash or, preferably half per cent formalin solution for several hours and then given two or three good rinsings in hot water.

Facilities for providing hot water for washing bottles should be required in every factory. Syrups should be prepared in aluminium vessels and stored in fly-proof cupboards.

The present arrangements for washing clothes in cantonments requires attention. The clothing of officers and even of married families is generally stored and ironed in crowded and filthy native dwellings in the bazaar. There can be little doubt that this procedure is a frequent source of sickness.

Regimental laundries, under efficient supervision, would be a great sanitary improvement.

Before closing this chapter we would like to invite attention to an amusing and instructive article in the *Journal of the Royal Army Medical Corps* by Colonel Fallon on what he calls some unclassed parasites which affect the soldier in India. The author very rightly points out that from "gunfire" to "lights out"—in some stations at any rate—the soldier is surrounded by obliging hawkers who supply him with cocoa, hot porridge, rice pudding, and "Bombay oysters" at intervals throughout the day. Where and how these luxuries, are prepared may take some finding and the hungry, or lazy, soldier does not stop to enquire.

"In these days, when we have to seek for other sources of odd cases of enteric than the controlled water and milk supplies, this question has a very serious side. The soldier is over-supplied with natives, particularly in stations where

he has extreme heat to bear. Generally low-caste, unclean beings, they are always at his hand, attending to his wants and, as has been seen, furnishing him with "dainties."

As well as shutting the big gates against enteric, these small postern doors have also to be looked to. It is not so easy as it seems to stamp out these trades. The soldier likes these people about him. The old soldier often finds that his snacks come cheaper than if he used his institutes; the young soldier has the feeling of his importance fed, by having retainers at call. Of course this must be qualified. Probably the majority of men get all their extra food in their institutes, but there is a large minority who patronise these folk. In the next place the spending power of a unit is sometimes not realised. A penny per day per man, in a fairly strong battalion, may amount to £120 a month, or more. So it can be seen how large a sum may be circulated among these hangers-on. The small sums these latter pick up, and which we see may become a large amount in the aggregate, have to yield their toll to whoever is strong enough to exact it, and so vested interests grow up which offer passive resistance to remedial measures.

Another qualification is now necessary. I am far from implying the above would fairly represent an average unit in India. Whether these customs prevail in many or few I do not know. I do know, however, that I have not drawn a fancy picture."

It is useless to reiterate the advice that soldiers are not to eat or drink in the native bazaars whilst supplies of equally doubtful origin are, as is suggested in the above extract, on sale on the verandahs of half the barracks of India.

CHAPTER VII.

The "Making" of the Soldier.

"The object of physical training is the production of a state of health and general physical fitness in order that the body may be enabled to withstand the strains of daily life and to perform the work required of it without injury to the system."—Manual of Physical Training, 1908.

The latest Army Medical Blue Book contains much information of the greatest interest to the regimental officer. The section on the physical training of recruits is of very special importance to all soldiers and puts the question so clearly that we cannot do better than reproduce it very little altered from the original.

It is pointed out that the prevalence of affections of the heart in the British Army has in recent years drawn much attention to the question of the physical training of soldiers.

The medical examination of candidates for enlistment in the British Army is probably more severe than that of any raised by conscription, and yet the proportion of soldiers becoming inefficient owing to heart trouble is far in excess of that in any Continental army.

This fact corroborates the view long held by many officers that in former years the physical training of the British soldier was unscientific and much too severe.

"The average British recruit is, on enlistment, the youngest and in poorer physical condition than of those of any civilized army."

Moreover they are nearly all inveterate cigarette smokers. They are unable therefore to face work which would not injure well fed conscripts of 20 years of age. Still less can they perform exercises which would do harm to robust men.

The argument that a very severe system of physical training is necessary in order that delicate recruits may be weeded out is misleading.

Many men are got rid of who might under proper conditions have developed into excellent soldiers, and, what is more serious, the great majority of those retained in the service are to some extent permanently damaged and their powers of endurance diminished.

The aim of the former system of training appeared to be the developing to a marked extent, of a few of the larger groups of muscles in as short a period as possible.

Gymnastic instructors were told that a recruit after three months' service should be able to—

1. Double for one mile.
2. Pull to the chest on the horizontal bar at least 10 times, hands reversed.
3. "Press up" at least 14 times on the parallel bars.
4. Jump a height of at least 3 feet.

These standards were much too high for ordinary recruits.

The heavy dumb bells and the violent exercises required for the speedy development of the muscles to the necessary strength, in too many instances, permanently injured the heart.

The maxim that a man is only as strong as his heart and that no muscular development is of any value which is obtained at the expense of an overworked heart were quite overlooked. Apart altogether from the question of the suitability of a system of gymnastic exercises as a means of physical training such exercises put a much greater strain on the strength of a recruit, probably enlisted after a long period of semi-starvation, than they would be on that of a well-fed civilian of the well-to-do working or lower middle class.

The recruit is, as a rule, in poor physical condition on enlistment. Yet when he commences his military exercises he never attempts to conform to the ordinary rules of "training" practised by athletes.

Notwithstanding, he was obliged under the old system to take more physical exercise than an ordinary oarsman or runner in civil life.

In 1907 the new system of physical training which was introduced the previous year, became general throughout the army, and at the same time physical drill with arms was discontinued.

The gradual decrease in the severity of gymnastic exercises has already been accompanied by a diminution in the prevalence of heart disease amongst the troops.

The system of physical training now in force is founded on, what is called the Danish modification of the "Swedish Drill." The scope and methods are fully detailed in the Manual of Physical Training, 1908.

The system is on the whole excellent, and is an immense improvement on the one which it has succeeded.

It is, no doubt, open to criticism, but time must be allowed to elapse before drawing definite conclusions as to its merits or short-comings.

The cavalry and artillery recruits' course may be too severe for many youths. The hearts of big men in soft condition are just as easily damaged as those of infantry recruits, and it is questionable whether the physical training should not have been as slowly progressive for the cavalry arm as for infantry.

The value of recreational gymnastics is also probably overestimated, and it must be remembered that men can strain themselves even at voluntary work.

Manly exercises such as boxing, wrestling, swimming, bayonet-fighting and fencing, should be encouraged in preference to tricks on the horizontal bar, bridge ladder, and pair of rings. It is hoped that the position of "attention" described in the Manual will soon be adopted on the parade ground.

Excessive "smartness" of drill or gymnastic movements should be avoided. Men anticipate orders sometimes with strained attention and this causes heart strain.

Each soldier should have his own gymnastic shoes. "Gymnastic shoes" for common use by any class going through cannot fit and are most insanitary.

Rubber soles should be adopted as they give confidence to the men and lessen the jar when jumping.

This subject has very special interest to soldiers in hot countries generally, and especially in India as 2,169 men have been invalided to England for heart troubles during the last ten years or an average of 217 yearly.

The question has arisen as to whether the prolonged heart strain caused by hill climbing done by soldiers, when stationed in the hills during the hot weather, may not possibly aggravate disordered action of the heart in men predisposed to the disease.

With a view to ascertaining whether this is so the men of several regiments stationed in the hills during the hot weather of 1907 were examined.

No less than 74 men of one infantry regiment were found to be suffering from the affection, and the medical officer in charge notes that when he examined the regiment about 18 months previously he found less than 10 men so affected.

From these reports it would appear that service in the hills may to some extent be responsible for the large number of cases of disordered action of the heart amongst soldiers in India.

There can however be little doubt that in addition to "khud climbing" excessive cigarette smoking is an important contributory factor.

Tobacco weakens the heart, and at the same time it contracts the small arteries of the body. This is a twofold evil as the resistance to the flow of blood is increased and the pump by which the blood is moved is weakened.

Special efforts should therefore be made to diminish cigarette smoking amongst young soldiers.

In this connection we may fitly conclude this resume of a valuable report on a subject of vital importance to the soldier by the following extract from the orders of the General Officer Commanding-in-Chief, H. M. Forces in Ireland :—

"The Commander of the Forces has during recent visits to Military Hospitals been again struck by the harm that the

increasing prevalence of cigarette smoking is doing the health of the Army. It is not confined to the Army, and Parliament is likely soon to deal with it as affecting the national health. Lord Grenfell appeals to the Irish Command to give earnest and early thought to combat what is gradually, but greatly, affecting its efficiency, and he requires all Commanding Officers to impress on those under their command the evils that inevitably result from this excess.

"We would point out that in other directions the health and well being of the troops in this command have greatly benefited from the loyal and intelligent co-operation of all ranks in giving effect to sanitary measures suggested by the medical authorities.

"He looks forward with confidence to a similar appreciation of his endeavour to mitigate the harm done by excessive cigarette smoking, especially among the younger soldiers.

"With a view to helping men to overcome the habit, the Commander of the Forces directs the smoking of cigarettes to be prohibited at certain times when, on the other hand, no similar restriction as regards pipe smoking will be made The smoking of cigarettes, therefore, will not be permitted when men are on fatigue or under arms on any occasion, including field operations and manœuvres."

The author has to thank Colonel A. A. Spottiswoode, Commanding the 1st Seaforth Highlanders for a copy of his Battation Orders for 1st February 1909, which contain the following order on cigarette smoking :—

"It has been brought to the notice of the commanding officer by the medical officer and from other sources, that a considerable amount of harm to the health of the battalion is being done by the very large amount of cigarettes that are being smoked by all ranks. The following order will be strictly adhered to from this date.

"Cigarettes will never be smoked by any officer, warrant officer, non-commissioned officer or man, when on any duty whatsoever, that is, when on manœuvres, field days, route marches, company parades, guards duties and fatigues, or when employed in any of the regimental institutes or workshops or any of the battalion offices, or when attending such offices "

It would be a good thing for our young soldiers in India, if all commanding officers were equally courageous in putting down this pernicious habit.

CHAPTER VIII.

Disinfectants and Disinfection in Military Life.

Prevention is the province where Medicine joins hands with "Common Sense."—Sir John Simon, First Medical Officer to the Privy Council.

Disinfection is referred to so frequently in the table at the end of Chapter I and plays so important a part in the prevention of the communicable diseases of soldiers that it merits some brief special consideration.

In recent campaigns its intelligent application has been the safeguard of our allies in the Far East, as may be gathered from the following extract from the book "Heroic Japan," a popular account of the war between China and Japan by *non-medical* writers :—

"Cholera broke out at Talien and on board the transports. Sanitary Committees were established at Talien, and these made stringent rules for the two services, disinfection being everywhere insisted on. A temporary Sanitary Department was specially established for the soldiers afield ; while in Japan besides the ordinary disinfecting stations other stations were opened in all important harbours. An average of 6,000 men were disinfected daily and altogether 150,000 men were subjected to disinfection, including soldiers and coolies.

"Everything coming from the infected ports was treated in like fashion : instruments, ships and all, particularly clothing and baggage. Every soldier's kit was covered with disinfectants or subjected to so great a degree of heat as to kill the disease germs.

"And so, despite the prevalence of epidemics abroad the disease did not find its way to Japan."

Such are the powers of disinfection when scientifically applied, but it must be realized that many sanitary sins are committed in its name as unfortunately both at home and

in this country the word "disinfectant" is not legally protected, with the result that it is habitually applied to substances of no value as preventatives of disease.

The object of all disinfection is of course to destroy the germs of disease. Three groups of agents are, however usually confused together under this single heading, *viz*:—

1. Antiseptics, *i.e.*, substances which arrest the action of microbes but do not destroy them, such as boracic acid.

2. Deodorants, *i.e.*, substances which counteract disagreeable odors, such as toilet vinegar and some *so-called* disinfectants.

3. Disinfectants proper, *i.e.*, substances which really destroy germs.

True disinfectants may be either :—

1. Natural.
2. Physical.
3. Chemical.

1. *Natural.*—Fresh air and sunlight are powerful natural disinfectants and will kill most germs.

All living micro-organisms are sooner or later attenuated in their disease-producing activities and finally killed by drying.

Thus the Spirillum of Asiatic Cholera, when dried, dies in from three hours to two days, according to the degree of desiccation; the bacilli of typhoid fever, tuberculosis and diphtheria resist drying for a longer time but gradually lose their vitality.

The influence of drying on the multiplication of bacteria—for none of them develop in a dry state—is of manifest military importance, as it shows that the maintenance of the habitation and surroundings of the soldier in as dry a state as possible is a stringent sanitary necessity. It becomes specially important in the case of troops under canvas when the thorough dryness of the tent site together with that of the bedding and clothing should be uniformly secured in the prevention or restriction of epidemics. The frequent

airing of bedding insisted on in previous chapters secures the desired dryness ; and in addition the oxygen of the air exercises a destructive effect on such organisms as may be harboured in the articles, whilst the agitation to which they are subjected in a strong breeze not only mechanically dislodges and removes a considerable proportion of the adherent microbes but also markedly interferes with the development of certain species.

2. *Physical.*—The physical disinfectants consist of heat in its various forms, *viz* :—

A. Fire.
B. Hot Air.
C. Steam and Hot Water.

Fire.—Destruction by fire is, of course, the most thorough means of disinfection, and it should always be employed for articles of little value. Where possible the material should be soaked in kerosine to ensure complete and ready combustion.

Native dwellings, which are cheap and readily reconstructed, are best disinfected by fire, especially in such diseases as plague, where the soil forms a breeding ground for the microbes of the disease.

It was undoubtedly the purifying influence of the Great Fire which freed London from plague in 1665.

Hot Air.—This method of disinfection is now largely discredited as it has been found to be unreliable. Its advantages are that an ordinary oven can be used for the purpose and that, within certain limits, it does not destroy articles such as leather and bound books.

Hot Water and Steam.—One of the best methods of disinfection is boiling. There are very few organisms which will stand boiling for a few minutes, and still fewer which will stand a subsequent washing in soap and hot water. Steam applied in special forms of apparatus, such as Thresh's, is now utilized at all large stations in India for disinfecting bedding and clothing. It is rapid, reliable and cheap, and will readily destroy vermin in clothing.

3. *Chemical Disinfectants.*—The number of chemical disinfectants on sale by chemists is enormous. They may be divided into—

A. Gaseous.
B. Liquid.
C. Solid.

A. The principal gaseous disinfectants are burning sulphur, formaldehyde and chlorine.

Burning Sulphur.—The gas produced by burning sulphur has been in use in England for many years as the most convenient form of gaseous disinfectant. It is essential that all surfaces with which the gas is to come in contact should be thoroughly damped as the sulphur only acts in the presence of moisture. Rolled sulphur, or the specially prepared candles, should be used as the powdered sulphur is frequently impure. 2 lbs. of sulphur are required for each 1,000 cubic feet of space.

Formaldehyde.—This gas liberated from tablets, or formalin, by heating in some special form of lamp has largely replaced sulphur of recent years.

Chlorine.—This element, which is prepared by adding an acid to bleaching powder, is a useful disinfectant. It is a powerful bleaching agent, and should only be used where the other two gases mentioned are not available. Half a pound of acid will liberate the gas from two pounds of chloride of lime.

For military purposes these gaseous disinfectants should be used chiefly as insecticides. For efficient use as disinfectants the rooms to which they are applied should be carefully sealed up and this is a very difficult procedure in dealing with the ordinary Indian room or barrack bungalow in the plains. In a degree of efficiency far short of that in which they will destroy bacteria they will however act as effective poisons to mosquitoes and other biting flies which survive in nooks and crannies from one year or another.

It should be borne in mind that the air of an infected room can be readily changed, and therefore does not require

disinfection. Moreover microbes have weight and do not remain in the air but sink on the floors and furniture, so our attention should be devoted to them and sulphur and other gaseous disinfectants reserved for destroying insects.

B. Liquid Disinfectants.—There are five substances or groups of substances in common use in the India as liquid disinfectants, *viz.*—

1. *Perchloride of Mercury or Corrosive Sublimate in solutions of various strengths.*—It has the advantages of being a most powerful disinfectant and cheap. Its disadvantages are that it is very poisonous to man but slightly so to insects, it corrodes metals, and its solution has neither color nor smell.

2. *Carbolic Acid* is a good disinfectant, but expensive and poisonous.

3. *Saponified Cresol* is the preparation officially adopted out of a great mass of tar oils now on the market. It is cheaper and more efficient than carbolic acid and not nearly so poisonous.

4. *Formalin* has been officially adopted by the War Office. It has an irritant odour but is harmless to colors and metal work with the exception of iron. It is a cheap and rapid disinfectant in 1 per cent. solution.

5. *Permanganate of potassium* is a disinfectant in five per cent. solution, but, as generally used, in less than half per cent. solutions it is merely a deodorant. Even when prepared in strong solutions it has three disadvantages :— it is expensive, it stains fabrics, and it is too easily reduced to an inert form.

C. Solid Disinfectants.—The only solid disinfectants of interest to soldiers are lime, bleaching powder and soap. Freshly burnt lime is a cheap and useful germicide. In the form of whitewash it is a disinfectant which plays an important part in our Indian life. It is important to see that lime used for disinfecting purposes is fresh as if stored for any length of time the action of the air converts a large

amount of it into chalk which has no germicidal properties whatever.

Some authorities have found that ordinary whitewashing destroyed all micro-organisms except those of anthrax (or splenic fever) and tuberculosis.

Prior to the application of whitewash the surface should be well scraped as we should aim at the removal of bacterial life from our barracks rather than its burial even underneath a germicide.

Chloride of lime, or bleaching powder, is a powerful but disagreeable deodorant, and a disinfectant of considerable power. It consists of lime saturated with chlorine, and is of very unstable composition. It corrodes metals and blocks drains.

It used to be largely *misused* in barracks to hide offensive odors, but it is hoped that quartermasters and their assistants now recognise that the proper procedure is to discover the cause of the smell and remove it. Its chief legitimate use in Indian barracks is to keep off flies, but for this purpose crude petroleum is much better.

Common soap must be regarded as one of the most generally useful of the chemical disinfectants and a most powerful agent against the germs of disease.

The alkalis in ordinary household soap not only actually destroy germs but also tend to dissolve the outer covering of their spores or seeds.

They also wash away the greasy materials which frequently protect bacteria from the action of the great natural disinfectants, sunlight and oxygen, and are therefore very valuable purifiers.

There is no doubt that one of the great reasons of the healthiness of the Anglo-Saxon race is its firm belief in the gospel of soap.

So much for the properties of disinfectants generally. We now turn to the practical application of disinfection in military life.

The Government of India in the Military Department has officially authorized two disinfectant solutions, *viz* :—

(*i*) Cresol solution made by adding 1 ounce of Saponified Cresol to 1 gallon of water.

(*ii*) Mercuric Chloride solution made by adding 140 grains of Corrosive Sublimate, 3 drachms of Hydrochloric Acid and a little aniline blue to a gallon of water. Cresol is similar in action to Carbolic Acid but cheaper and more powerful.

When a case of infectious disease is notified, the Commanding Officer should at once isolate all contacts for the period laid down in the Table at the end of Chapter I. As a rule disinfection will be carried out by the medical authority, but in the absence of a competent medical adviser the following simple rules should be observed :—

1. Whenever a steam disinfector is available all articles of bedding, carpets, hangings, &c., which are not likely to be injured by steam should be sent to the disinfecting station.

2. When a steam disinfector is not available cotton and linen articles should be boiled for half an hour. Blankets, other woollen articles and coir fibre should be soaked for two hours in Cresol solution. Cloth articles, such as tunics, should be sprayed with a five per cent. solution of pure Carbolic Acid in water and exposed to the sun for 3 or 4 days. Leather articles should be sponged with Cresol solution.

3. Feeding and cooking utensils should be boiled for 15 minutes.

4. The walls of the room occupied by the patient should be scraped and re-limewashed.

5. Furniture, floors and wood work should be scrubbed with hot water and soap.

6. Earthern floors should be saturated with the Mercuric Chloride solution.

7. The wood work of the latrine used by patient should be scrubbed with Mercuric Chloride solution and the floor saturated with the same solution.

8. The urinal trough should be scrubbed with Cresol solution and the floor treated as laid down in rule 6.

9. If the patient occupied a tent it should be saturated with either of the official disinfectant solutions and the interior exposed to the sun for four days.

10. It is a wise precaution to disinfect any adjacent well by adding two ounces of quicklime or a drachm and a half of permanganate of potassium to each gallon of water which it contains. In adding the solution of permanganate or emulsion of lime care should be taken to wet each part of the well. The formula for calculating the amount of lime necessary to disinfect a well is :—

(Diameter of well in feet) ^{2} × (Depth of water in well in feet) = Number of pounds of lime required.

The answer to the same formula multiplied by ·1 will give approximately the number of ounces of permanganate of potassium required.

11. If no disinfectants are available boil everything, which can be boiled, for half an hour.

Scrub everything, which can be scrubbed, with hot water and soap and expose everything else in the sun for a week.

It must be remembered that not only invisible microbes but visible insects are transmittors of disease and war should be waged against all insect life. As destructive weapons against them Cresol and the other special tar oils will be found to be the most effective of all the agents we have considered.

It will be observed that, with the exception of the Cresol group, good disinfectants are not necessarily good in-

secticides as kerosine oil and crude petroleum, for instance, which are very feeble disinfectants, are good insecticides, whilst Mercuric Chloride, although the most powerful of disinfectants has, as we have seen, little influence on insect life.

CHAPTER IX.

The Soldier in Camp and on the March.

For the Lord thy God walketh in the midst of thy camp . . . . . therefore shall thy camp be holy; that He see no unclean thing in thee and turn away from thee.—Book of Deuteronomy, Chapter XXIII, v. 14.

Nearly four thousand years ago there was a great general and his name was Moses. He passed many years of his life in the supreme command of great camps in a tropical country and it must have soon become apparent to him that unless strict sanitary legislation was enforced the troops under his command and their followers would have been decimated by the various diseases which, as we have seen, dog the footsteps of every great host on the line of march.

Moses was learned in all the wisdom of the Egyptians, and he set about the question in the only way which would appeal to an ignorant and superstitious people.

He accordingly published the general order which has been selected as—so to speak—the text of this chapter declaring that the God of Israel was fond of walking in the camp of His children and that, therefore, it must be kept in a sanitary condition.

His device was successful for we know that his great following passed through its long years of a nomadic existence singularly free from epidemic disease. We cannot copy him by making our sanitary rules part of the ritual of a great faith nor can we make our men believe, like the Japanese, that the spirits of their ancestors hover round the bivouac fires, but we can adopt the first principle of Moses and start our camp or our march with clear orders on sanitary subjects and a definite sanitary *bandobust* and *personelle.*

The first thing to be done, therefore, is for the General Officer Commanding to issue orders for the formation of

sanitary sections for each unit and definite instructions with reference to camp sanitation. Orders should be as concise as possible consistent with clearness .and, where possible, accompanied by diagrams which are of great assistance to quartermasters and the non-commissioned officers of Sanitary Sections.

The sanitary sections should consist of a non-commissioned officer and eight men from each regiment.

The choice of men must of course rest with the officer commanding, but where possible regimental pioneers should not be detailed for the service for the following reasons, *viz* :—

1. The sections should be permanently employed for sanitary work and have no other duties.
2. They should have some special training.
3. They should be divided into two parties. One should accompany the companies on the march whilst the other should proceed with the advance party to prepare the sanitary arrangements of the camping ground.

If regimental pioneers are detailed for the work it is obvious that these requirements can hardly be complied with.

The following points require consideration with reference to camps :—

1. Sites.
2. Tents.
3. Water-supply.
4. Cooking arrangements.
5. Latrines and urinals.
6. Disposal of refuse.
7. Ablution and miscellaneous details,

Sites.—Definite instructions on this subject are laid down in Combined Training.

It is obvious that in the presence of an enemy tactical considerations, such as favourable ground for defensive

purposes, must claim first importance, but the comfort of the troops, in conjunction with sanitary conditions, is the next consideration.

The site for a camp or bivouac should, if possible, be on a gentle slope to facilitate drainage.

The vicinity of large woods with undergrowth, marshes, paddy fields, or recently ploughed land ought be avoided as mosquitoes and biting flies are likely to be plentiful in such localities.

Should it, however, become necessary for military reasons to encamp troops near ground likely to be infested by mosquitoes the camp should be pitched to the windward of a belt of trees or a screen of some kind with a view to intercepting the wily mosquito in her flight.

Ravines and water courses are dangerous sites as a sudden fall of rain may convert them into large streams.

Previously occupied ground should always be avoided, as the soil must have been contaminated and polluted to a greater or less extent, and there is always a possibility that "carriers" of disease may have been present infecting the vicinity with the microbes of enteric or some other disease.

Old camping grounds can be readily recognised by the raised mounds marking the site of the latrines.

An ideal site would be a gentle slope free from any great irregularities of surface, situated near the summit of rising ground on a sandy or gravel soil and adjacent to a mountain stream which has no huts or villages on its banks.

Needless to say such sites are not easy to find under the stress of active service, but camping grounds conforming to most of the essential requirements are to be found within reach of many stations.

When possible a camp should always be arranged as if for permanent occupation. In regular standing camps it is especially desirable to provide sufficient space for the moving of tents so as to cleanse and purify the ground underneath each tent at frequent intervals.

The minimum space allowed for different units on field service is laid down in Combined Training, p. 37.

Briefly stated a cavalry regiment is allotted 5½ acres, a battery of field artillery nearly 2⅓ acres, and an infantry battalion 2 acres.

Sanitarians recognise a distinct relation between density of population and the prevalence of disease, and when it is realized that this area gives over 500 men per acre in the case of an infantry battalion, whilst in the most crowded district in England only about 100 persons per acre are accommodated the necessity for the greatest zeal in the enforcement of sanitary precautions in camps becomes at once apparent.

Tents—What has been said with regard to space generally becomes emphasized when we consider the air space provided in the tents.

The tents in use by the Indian Army are :—

British Privates or E. P.—The tent is used for standing camps and for inland service such as marches from one station to another. It accommodates sixteen healthy or eight sick men. The air space per man provided is rather over 148 cubic feet.

General Service.—This tent is used for field service, and accommodates sixteen British or twenty native soldiers. The cubic space per man is a little under 43 cubic feet.

General Service (Small).—This is the 80 lb. tent largely used on the frontier where mobility and lightness are all important requirements. It accommodates eight British or ten native soldiers, giving the former exactly 49 cubic feet of air space.

It is necessary to ask the reader to give these figures some consideration and to contrast them with the fact that the soldier in an Indian barrack room is provided with over 1,400 cubic feet of air space.

The figures show that the soldier, under the trying conditions of field service, has only about one-thirtieth of the air space he would have in barracks.

Moreover, whereas the barrack room is generally efficiently ventilated, the means of ventilating tents are very imperfect.

Under these circumstances the use of tents where climatic conditions are favourable to bivouacing has no sanitary advantages, but it must be admitted that the discomfort involved by prolonged residence in the open air must have great weight in adopting the use of shelters of some kind.

Certainly the men should be taught to sleep with their tents open. Colonel Firth calls attention to the well established fact that the risks involved by the exposure of healthy individuals to vicissitudes of weather are very slight and much exaggerated, both in and out of the service, but it must be remembered that in India a large number of men are to some extent "crocks," and that exposure, which would do little harm in temperate climates, may result in a return of old trouble in the form of dysentery or malaria.

Some foreign armies have special shelter tents which largely take the place of regular tentage. There is no official pattern for the British Army, but four excellent types of shelter are described and figured in the Manual of Military Engineering (Section 192).

When no other materials than earth and brushwood are available, a comfortable bivouac for 12 men can be formed by excavating a circle with a diameter of 18 feet or thereabouts and piling up the earth so as to form a wall 2 or 3 feet high. The men lie down in the centre like the spokes of a wheel with their feet towards the centre. Branches of trees or brushwood stuck into the wall improve the shelter.

It is laid down in Combined Training (Section 49) that all tent flies are to be looped up the first thing every morning and that the tents are to be struck periodically, and the ground underneath well swept and left exposed to the sun and air for some hours. The interval between the striking of tents should not exceed 3 or 4 days, and it is desirable that a second site should be available to which the tents can be moved if desired. Tent doors should always face the prevailing wind.

Trenches should always be made round tents to receive rainwater and channels cut to carry off this water and provide surface drainage.

In malarial districts mosquito nets may be used with advantage. These are the instructions in Combined Training, and therefore as these nets are not yet supplied to troops in India it is desirable that some attempt should be made to provide them under regimental arrangements.

The cost is not prohibitive, as they are provided by Master Tailors in the First Division at about two rupees each.

The entire contents of the tent should be spread out in the sun daily. This is a sanitary precaution which should never be omitted.

Where a prolonged residence in one locality is necessary tents should invariably be replaced by huts. Several types of hut are figured and described in the Manual of Military Engineering.

Where possible huts should be provided with a movable roof, and the various materials suggested in the Manual might well be replaced by stout tarpaulin. This material is portable and durable and its adoption would permit of rapid removal of the roof for airing and sunning the interior of the huts.

Water Supply.—A good water supply is essential for a camp, but military considerations may necessitate the camp being placed at a considerable distance from it. The water supply will, of course, be selected by the Regimental Medical Officer who would be greatly aided if, as in the case of the Japanese army, a sanitary expert could move forward with the advance party of scouts or engineers to inspect and label wells and other sources of supply.

The flags for marking the different kinds of water are laid down in Combined Training (Section 43, para. 5). The Sanitary Officer would not be able to carry out

careful or microscopical examinations of the waters, but he could be provided with some re-agents which together with his special knowledge of sources of water supply would enable him to give advice, which, though falling far short of accurate analysis, would be of great assistance to the regimental surgeons.

Men from the sanitary sections of the first troops arriving at a halting ground should mount as sentries on all water likely to be required for use and should take steps to prevent any form of pollution. These sentries should not be withdrawn till permanent water guards are detailed.

The advance party may require to make a rough calculation to see if a stream is likely to yield sufficient water for a force.

This may be done as follows :—Select 12 or 15 yards of the stream where the channel is fairly uniform and there are no eddies. Take the breadth and average depth in feet in three or four places. Drop in a chip of wood and take the time it takes to travel, say, 30 feet. The result is the surface velocity.

From these data the following formulae will give yield in gallons per hour :—

Surface velocity $\times \frac{4}{5} \times$ width $\times$ average depth (in feet)
= yield per second in cubic feet.

Yield per second in cubic feet $\times$ 6·25 $\times$ 360.
= yield in gallons per hour.

All water receptacles should be thoroughly cleansed out daily with a solution of permanganate of potash made by adding one teaspoonful of the crystals to three gallons of water. If after rinsing the solution comes out discolored it shows that cleansing was necessary. Repeat the process till the water retains its pink color unaltered.

All vessels for storing water in camp must be kept carefully covered and provided with taps. Drinking direct from taps or direct from storing vessels of any kind, should be made the subject of disciplinary measures.

Where possible separate intakes for water supply should be provided for British and Native troops.

Drinking places for animals and ablution places for men will be always allocated lower down stream than these intakes. Horses and animals will be watered from troughs where possible to avoid unnecessary fouling of streams.

The principles affecting water supplies generally which have been laid down in Chapter III apply, of course, where practicable to camp supplies.

Cooking arrangements.—Camp kitchens should be situated (*a*) as far away as possible from the latrines, urinals and refuse receptacles, (*b*) to the windward of the camp, and (*c*) as near as possible to the water supply.

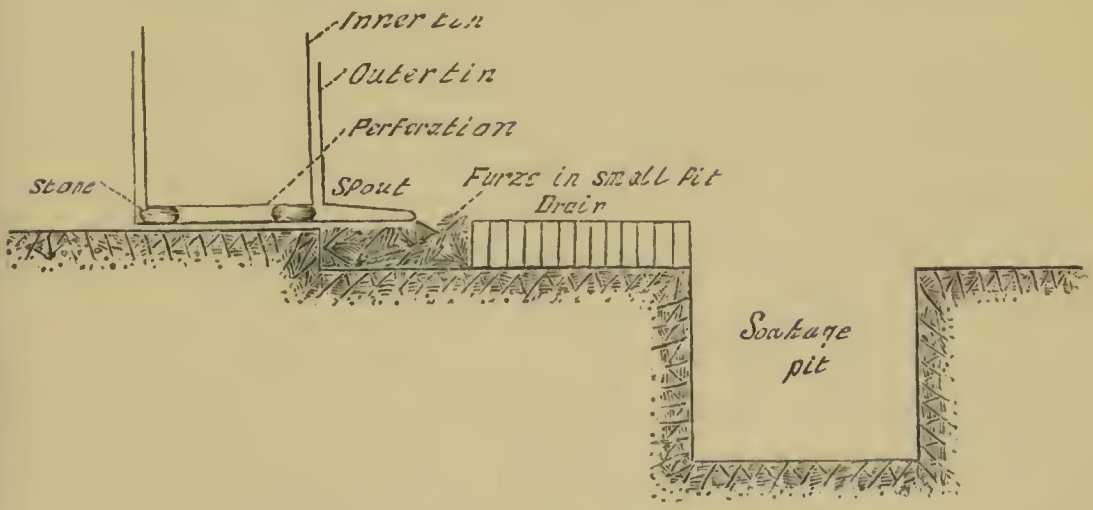
Various simple methods of building camp kitchens are laid down in the Manual of Military Engineering, but no device is suggested for getting rid of sullage water.

Kitchen waste water contains a large amount of grease, and unless specially treated this subtances forms a foul scum in water drains which rapidly becomes offensive and always attracts flies.

The following methods of disposal suggested by Captain Tilbury Brown have been found to be good and easily improvised :—

1. Two kerosine tins of different sizes or a tin and a basket are taken. The inner and smaller tin or the basket acts as a coarse strainer. When a tin is used it has its bottom perforated all over with a nail. When full it is emptied into a refuse tub. The outer and larger tin directs the water over a small pit which acts as a grease trap, and is filled with dried grass, hay, or brushwood, which is burnt and renewed daily. A narrow and shallow trench ran from the small pit into a large soakage pit. If *large* stones are available, the soakage pit should be filled up with them. The spout of the lower tin is easily made by making an inverted

V-shaped incision in its side, turning it down and rounding off.



2. This is simply an adaptation of 1. When two tins or a tin and a basket are not available, a box is turned upside down over the the small pit, a hole is cut out in its bottom, and a piece of perforated tin fitted into the hole.

3. A grating placed over the soakage pit on which furze or other straining material is placed. It is not so efficient or cleanly as 1 and 2.

In all the varieties the brushwood or grass used to entangle the grease should be soaked in crude petroleum to keep off flies. It should be replaced by fresh material and burnt daily.

All food should be kept in covered receptacles and some form of swill tub devised. Refuse should be sprinkled with petroleum to keep off flies and transported to the camp crematory as soon as possible. Washing up should be carefully arranged for, and a modification of the system suggested under Cookhouses (page 80) should be adopted. All water for washing up should be boiled and only well baked sand, wood ashes or bathbrick, used for cleaning utensils. The use of *mutti* should be prohibited as it may swarm with microbes.

Latrines and Urinals.—These should be placed to the leeward of the camp and one hundred yards from the

nearest tent. They must never be dug in nullahs whence the excreta may be washed into a water supply by heavy tropical rains. A man from the sanitary section should, in accordance with the Field Service Pocket Book, be placed in charge of each latrine, his duty being to see that every man covers his excreta with earth. Failure to carry out this practice should be punished.

Latrines are generally constructed in accordance with the Field Service Pocket Book (plate 7) for 5 per cent. of the troops, one yard being allowed for each man.

When a camp is only likely to be used for one night a small shallow trench, 1 foot broad, 2 feet deep and 3 feet broad will suffice. The men use these trenches by squatting straddlewise across them.

Some means of scooping up the earth for covering excreta should be devised as the method of pushing it into the trench with the boot is neither cleanly nor accurate as the man frequently fails to locate the earth in the correct position.

Empty tins are excellent for this purpose and are always to be obtained in a standing camp.

Means for preventing paper being blown about the camp must also be devised. The issue of a little string will generally be all that is necessary for unused paper, but unfortunately it is generally the used paper which is found flying about.

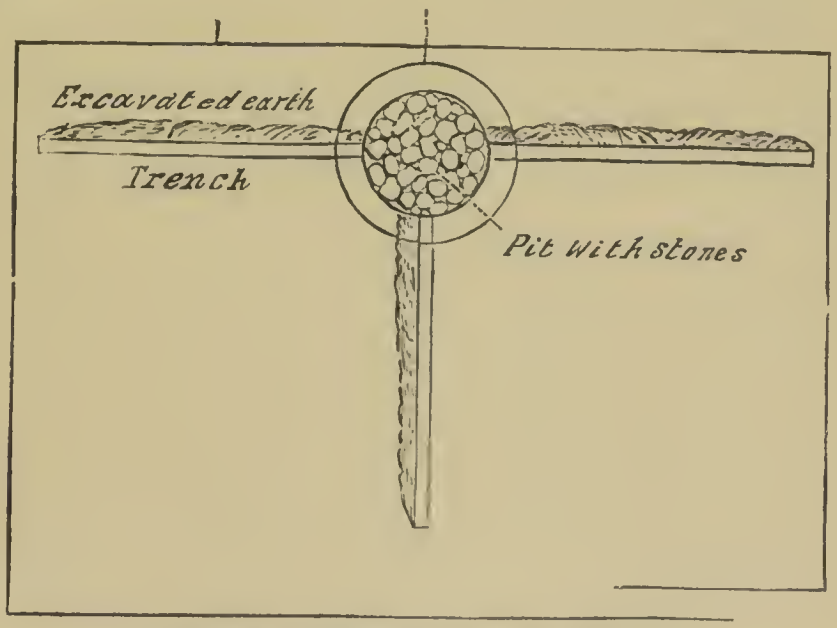
The best type of camp urinal consists of shallow trenches leading into pits filled with large stones. The men urinate into the trenches and the urine flows into the pit and soaks into the ground.

Two trenches about 6 feet long leading to a circular pit 3 feet deep and two feet in diameter are sufficient for a battalion.

The trenches last for a day or two. When foul it is only necessary to dig fresh trenches leading to the same pit, as the latter will last for about a fortnight.

The new trenches should move round the pit like the hands of a watch.

The attached diagram is from Captain Tilbury Brown's paper on Camp Sanitation in the *Journal of the Royal Army Medical Corps* (published by kind permission of the Editor).



Tilbury Brown's Camp Urinal.

For night use receptacles for urine should be placed along the streets and flanks of the camp and not in the lines. They should be marked by whitewashed posts and lighted when possible. Where camps are likely to be occupied for any length of time some plan for the reception of excreta in receptacles should be adopted.

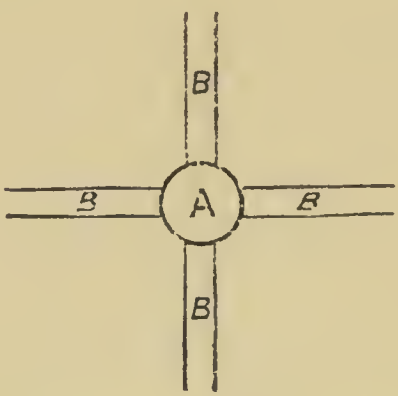
Colonel Caton Brown has devised a plan for utilizing kerosine tins as receptacles. Two or three inches of a disinfectant solution are placed in the receptacles and the contents disposed of by burial.

This plan obviates the plague of flies which is almost unavoidable when trenches are used in hot weather.

Disposal of Refuse.—All waste food stuffs, stable litter, and other refuse must be burnt. This is clearly laid down in Combined Training but unfortunately it is not always carried out.

An excellent type of destructor is figured in the *Field Service Pocket Book* but the pattern devised at Aldershot by Lieutenant-Colonel R. Caldwell, R.A.M.C.,* has much to recommend it.

It consists of two short trenches about the depth of those of an ordinary camp kitchen. These trenches intersect each other at right angles, and a chimney made of sods of earth is built over the angles of intersection. A few pieces of iron hooping support the chimney where it crosses the trenches.



A—Chimney, B B—Trenches.

A fire is lighted at the base of the chimney and the rubbish thrown down the top. The addition of a little turpentine or kerosine oil to the rubbish helps matters immensely. There is a fair draught through the trenches and up the chimney, and if the rubbish is put on with ordinary care the fire generally burns itself out. †

Slaughtering places should be well removed from the troops and all offal burnt in a Caldwell's or Arnold's Crematory.

In camps of mixed European and Native troops these places should be arranged so as not to offend the susceptibilities of Hindu soldiers.

* Prevention of Disease in Armies. By Lieut.-Colonel Caldwell.

† Lieut.-Col. B. Skinner, M.V.O., has devised a scheme by which Caldwell's Crematory, without the cross-cut trench, can be utilized for the disposal of all animal excreta of troops in the field, *vide* Journal of the R.A.M.C., April 1909.

Dead animals should be dragged to some specially selected site.

Unless the animal has died of some infectious disease the entrails should be removed and burned. If fuel is available the carcass should be dessicated by lighting a fire inside it.

Ablution and Miscellaneous.—Careful arrangements should be made for disposal of waste water from ablution places as soapy water is likely to cause offence and encourage flies.

The method suggested for kitchen waste can be readily adapted for ablution rooms.

In standing camps some facilities for baths should be provided if any high degree of personal cleanliness is aimed at.

Hot water can readily be provided by boilers, and if fuel cannot be obtained an effort should be made to provide it through regimental arrangements.

It is useless to expect men to bathe unless some degree of privacy is provided.

On manœuvres in England this is appreciated and enclosures and even marquees are provided, divided into compartments, by canvas screens. Each compartment contains a seat, foot grating and a metal or canvas bath. The bath discharges over a trough made of strips of galvanized iron or into shallow drains.

The disposal of the waste water from these temporary baths presents considerable difficulty in some places in England, but should not be a difficulty in India where there is usually considerable waste space in the vicinity of camps.

Facilities for drying clothes should always be provided in large standing camps in the Indian hills. There is no better plan than to utilize some form of frame work with angethis underneath it for this purpose, but, as previously pointed out, this service must not be carried out in tents in actual occupation as angethis give off a poisonous gas.

Special tents or sheds must, therefore, be provided for this purpose. In camps, which are likely to be occupied for some

time, beds of some kind should be provided. Elaborate instructions for the preparation of grass mats for use as beds are given in the Engineering Manual (Section 197), but grass suitable for plaiting is rarely available in India.

The best device in frontier camps is to scoop out about 6 feet by 3 feet of the floor of the tent to the depth of about 3 or 4 inches and fill the space up with bhussa or chopped straw. The waterproof sheet is then spread over the bhussa. It will be found that beds of this kind are both warm and comfortable.

Hour of Starting—The Line of March.—When there is no chance of meeting an enemy the health and comfort of the troops should be the first consideration in making the arrangements for marches.

Human life is physiologically at its lowest ebb between 2 and 4 a.m. and man obtains most of his rest in the early hours of the morning. When practicable, therefore, the hour for starting should not be before daylight and until after the men have had their breakfast.

Tactical considerations, the length of the march or the state of the weather may, however, necessitate starting before daybreak. It is preferable to start in the dark rather than reach the destination late. The halting place for the night should certainly be reached about two hours before sunset to enable all arrangements to be made for the camp before nightfall.

In hot weather it is advisable to start early so as to avoid the heat of the day. When a long march is contemplated under such conditions the regulations recommend that a halt of three or four hours should be made in the middle of the day so as to enable men and animals to have a good rest and their midday meal. It will be found that the march will be completed more quickly and with less fatigue if this is done.

The distance which should be marched in a day must of course vary according to military necessities, but it will be found that fifteen miles marched at the rate of eighteen

minutes to the mile, is a good average for infantry. Mounted troops cover the mile in 15 minutes at a walk and in about 8 minutes at the trot.

Whilst straggling is to be deprecated the movements of the individual soldier should as far as possible not be impeded by restrictions of an unnecessary nature, and every effort should be made to convert what is the most essential of all military movements into a salutary exercise.

The length of the marching step in our army is 30 inches and the cadence 112 to the minute.

In this relation Colonel Firth points out that the method of marching known in the French Army as the *pas de flexion* is worthy of more consideration than it receives in our Service.

This style of progression resembles the gliding lope or shuffle in use amongst some half-savage races.

The body is bent well forward and the foot raised very little from the ground.

Short quick steps, about 160 to the minute, are taken at first and gradually increased in length. The feet are brought to the ground glancing rather than flat so as to lessen the force of impact which is one of the most wearying features of ordinary marching.

By carefully graduated practice the French are able to attain such a high degree of efficiency in this kind of marching that after three months' training their fully equipped infantrymen can cover seven miles an hour with as little effort as when marching in the ordinary way at not more than half the speed !

Halts are necessary in all marches to give the muscles an opportunity of rest.

"Combined Training" provides for a short halt half an hour after starting and five minutes per hour subsequently.

Every effort should be made to prevent reckless fouling of ground at halting places. Men of the sanitary section should report to the officer commanding the company or

companies to which they are attached as soon as the unit halts and indicate a suitable place for the men to go to on "falling out."

The sanitary section men should accompany the men falling out and see that they cover their excreta with earth before rejoining their companies.

Failing the facilities provided by the "paddle on his weapon" necessitated by the Mosaic law, the British soldier can easily cover his dejecta with some loose earth scraped up with the bayonet, sword or even the boot.

When long halts are made the sanitary section men should dig a few short trenches for defæcation purposes and one or two shallow trenches about three inches deep for use as urinals.

Whilst men are on the move every effort should be made to keep their minds occupied. Choral efforts, soloists, and whistling should be encouraged in every way and some system of company instrumentalists might be adopted as in Highland Corps to aid the band which must rest occasionally.

Every officer has noticed at the end of the day's march how the men's steps flag when the band stops playing.

Troops should be trained to refrain as long as possible from drinking on the march, to drink sparingly, and to always keep a reserve in their water-bottles.

The old soldier's plan of sucking a pebble to keep off thirst should be taught to their younger comrades.

Men should never be allowed to fall out for water. "Combined Training" says that when necessary halts should be made for the purpose but, as in India, ordinary supplies are rarely safe, this should not be done unless the water can be boiled or filtered.

The causes of falling out on the march are not numerous, provided "crocks" have been carefully weeded out before starting.

Briefly stated they are :—

1. Sore feet.
2. Colic or diarrhœa.
3. Sunstroke.

Sore Feet.—Foot soreness is frequently associated with sweaty feet.

This condition is best treated by strict cleanliness, soft smooth socks, and well fitting boots.

The applications recommended are a lotion consisting of a half per cent. solution of formaldehyde in water and a two per cent. ointment of salicylic acid made up with soft paraffin.

The former is used to bathe the feet a couple of times daily, and the latter applied at night before going to bed.

A great number of proprietary powders are sold to harden the feet for marching.

Boracic acid or a mixture of 3 per cent. salicylic acid and ten per cent. starch in powdered talc are the best, but where the socks are whole, or properly darned, and the boots well fitting nothing of the kind is necessary.

Blisters are best treated by applying two strips of Mead's plaster in the following way. The first piece has a hole cut in it as near as possibly the same size as the blister.

It is applied and covered by the second piece which covers the blister and the first strip of plaster.

The regimental chiropodist should be very actively employed attending to corns for some time previous to the march. He should be provided with the formaldehyde lotion and "walking powder" in liberal quantities, and encouraged to see that the men use some methylated spirit or alum solution for sponging their feet after the march.

The old device of soaping the socks is insanitary and undesirable.

Colic and Diarrhœa.—These are due to bolting the food or partaking of indigestible dainties the night before the march.

Advice on the necessity for careful mastication of the food and *discouragement* of apparently preventable causes for falling out are all that can be done by the regimental officer.

Sunstroke.—This condition in a mild or severe form has been the cause of much loss of service during hot weather marches in this country. Medical men are not quite agreed as to the cause of the condition. Colonel Duncan of the I.M.S. read a paper on the subject in London last May, in which he pointed out that no fewer than four theories as to the cause of sunstroke had their adherents. He himself holds that it is due to what are called the actinic rays of the sun which can pierce through anything except a layer of color which acts as a filter. The color which keeps out these rays is orange red, and it is recommended that all helmets should be lined with a piece of orange red flannel and a pad of the same material worn along the spinal column. This is a simple precaution to take and well worthy of general adoption. The Government are now experimenting with a helmet lined with red material so that they are thoroughly alive to the latest suggestions for diminishing the risks run by the soldier in India.

It must be remembered that alcohol is distinctly conducive to sunstroke, and it should therefore never be partaken of when on the march.

The classical symptoms of an acute case are sudden insensibility with flushed face and convulsions, but there are many degrees far short of this in which the man only turns pale and faints, or complains of giddiness or dimness of vision.

The treatment of the condition is simply to place the patient on his back in the shade, loosen his clothing, and pour cold water over his head until medical advice can be obtained.

CHAPTER X.

Venereal Disease in the Army.

Who would not do a little to prevent
What he would give a thousand worlds to cure?—Young.

Of all the causes of inefficiency in military life venereal disease is the most important, as it causes more admissions than any other group of diseases at Home stations. For example, during the year 1907, altogether 438 military soldiers per 1,000 of strength were admitted to hospitals in the United Kingdom. Out of these nearly 72 per thousand were suffering from venereal disease. In India the disease does not hold such a high place on the sick reports as it has such important rivals in the tropical ailments which flourish only in this country. Yet during the year 1907 out of 756 admissions per thousand of strength nearly 80 were for venereal disease.

It is obvious, therefore, that such a serious annual loss of strength to the army is well worthy of the consideration of combatant officers, especially as the British Service stands highest on the list of European Armies for inefficiency for venereal maladies as will be seen by the following figures from the latest Blue Book :—

United Kingdom	71·9
France	29·1
Germany	18·8
Austria-Hungary	60·6
Russia	59·2

We have, however, the grim satisfaction that the British Service is not nearly so bad as the American as the admistion rate in the United States Army in 1906 was actually 158·9 or nearly double the latest figures for our army even in India.

Under the heading venereal disease three maladies are grouped, *viz.* :—

1. Syphilis
2. Gonorrhœa
3. Soft Chancre.

It may be useful to briefly consider these types separately.

Syphilis.—This variety of venereal disease, popularly known to soldiers as the Pox, is world-wide in its distribution, and especially prevalent in India.

It is due to inoculation with a microscopic animal which produces very grave constitutional disturbance.

Cracks or abrasions of the parts are not necessary for the reception of they microbe though they undoubtedly favor it.

About three weeks after exposure to infection a small red itching pimple appears at the site of infection.

It gradually developes into a painless ulcer which is followed in about six weeks by what are called the "Secondaries."

These are characterized by a typical rash on the forehead, chest and arms, and by more or less sore throat.

Other symptoms may or may not be present.

Even if treatment is not carefully carried out the symptoms may subside in a month or two, but unless a cure has been effected, after a latent period of two to ten years the disease will assuredly break out again in the form of affections of the skin, bones, or internal organs.

It is, therefore, a very terrible form of blood poisoning and one cannot help thinking that if its terrors were realized few soldiers would be frequenters of the Gora Chuklas of Indian bazaars where it inevitably awaits the customer sooner or later.

Perhaps the worst feature of the disease is its extreme infectivity.

A soldier suffering from "secondaries" is a potent source of danger as he may convey the disease to a comrade by means of his pipe, or eating utensils.

It has frequently been conveyed to sweethearts by kissing.

Section commanders should insist on the importance of men always using their own spoons, mugs, &c., and point out the undesirability of having a "draw" from another man's pipe.

Gonorrhœa.—This disease is not so serious in its consequences as syphilis, but it is frequently followed by partial closure of the urethra, which renders old age miserable from difficulty in passing water.

The disease is due to a micrococcus which produces intense inflammation of the water passages with a purulent discharge.

The symptoms appear on an average three days after exposure to infection, and are very variable in their duration.

Men should be instructed to go sick immediately the condition appears, as absolute rest is an essential portion of the treatment.

If they persist in continuing at duty the inflammation may spread up the urethra to the bladder and even to the kidneys with the most serious results.

Like syphilitics men suffering from gonorrhœa are a potent source of danger in a tent or barrack room.

The microbe of the disease produces a very virulent type of ophthalmia, and if a drop of discharge should find its way into the eye of either the sufferer himself or one of his comrades it is capable of producing an inflammation which in a few days may result in complete blindness.

Soft Chancre.—This is a very contagious ulcer only found on the private parts. It usually appears the day after infection. As a rule it causes no constitutional symptoms but is frequently complicated by painful buboes or suppurating glands, which necessitate prolonged treatment. In India a very severe type of ulcer is occasionally seen which leads to serious consequences.

This condition can only be diagnosed from syphilis by a skilled surgeon.

Prevention of Venereal Disease.—This type of disease was by no means unknown to the Israelites, and several sections of the Mosaic law are directed towards its prevention.

In all foreign armies and in most continental countries there are definite regulations to diminish the risks of infection, but although the wilful exposure of persons suffering from infectious disease is punishable by the English Law it is strange that a public plague like syphilis, whose effects are infinitely worse than that of any infectious disease, should not lie under any restrictions (Lewis and Balfour's Public Health, page 27). One cause of spread of a limited but important nature is latrine contagion from discharge deposited on the seats. It can be avoided by cleansing latrine seats with a disinfectant as recommended in Chapter VII. Infection by the micro-organism of syphilis is not very rapid and therefore prompt and careful washing of the parts with a reliable disinfectant such as Lysoform (1 per cent.) is useful.

Two famous French scientists have recently reported to the French Academy that an ointment consisting of one part of calomel to two of lanoline has proved to be an absolute preventive if rubbed into "the privates" within twenty hours after exposure to infection.

In support of their contention they give details of many experiments not only on monkeys, but also on a young medical student, who, in the interest of humanity, permitted himself to be inoculated with syphilis.

The gonococcus, or microbe of gonorrhœa, and the bacillus of soft chancre are very rapid in their action and ablution of the most careful type usually fails to prevent infection.

An attempt is now being made in the Austrian Army to prevent venereal disease by the establishment of special ablution rooms situated at the entrances to all barracks.

The men are encouraged, but not compelled, to wash in the parts in 1 in 1,000 of perchloride of mercury and inject a solution of a silver salt called albargin.

Careful registers are kept, and it is said that in some garrisons the diminution in the number of admissions from venereal disease amounts to over sixty per cent.

All these methods must be regarded as mere attempts to avoid receiving the wages of sin.

Chastity and purity of life are the only reliable preventives of these loathesome complaints which loom so large in our military bills of health.

There can be little doubt that these diseases could be largely prevented if their dangers were explained to men by their own officers and section commanders.

One point which is not sufficiently appreciated is that men frequently expose themselves to infection in consequence of the popular notion that sexual intercourse is necessary for the preservation of health.

This is an absolute fallacy. Sexual pleasures are a pure luxury and not essential to any man. Certainly the immature youths of which the bulk of our army is composed would be far better, and far healthier, men without them.

CHAPTER XI.

Sanitary Organization in Peace and War.

"The medical history of the Crimean War is a shameful story, and tells how an army may be destroyed by a Ministry through want of ordinary forethought and ignorance of military science: the General can learn from its pages the important lesson that the greater attention he pays to the health of his men, the stronger will be his battalions on the day of battle."—Outlines of Military Geography by T. Miller Maguire.

"Prevention is better than cure" is a very old adage, but it has only come to be applied to medical matters, even in civil life, during the latter part of the last century.

Up till comparatively recently the soldier has merely looked upon his comrade, the military surgeon, as an agent in the treatment of disease, and has not recognised his far more important function of suggesting measures to prevent that treatment ever being required.

Medical officers of health now take a prominent place and play a most important part in the public life of counties, cities and municipalities, both at home and in this country. Naturally the Indian and Imperial Governments have not failed to follow the lessons learnt from civil experience and have appointed their own military medical officers of health for the divisions of the Indian and Commands of the Home Army.

These officers have, almost invariably, studied under the medical officer of health of some large town in the United Kingdom, and must hold exactly the same special diploma and qualification which are required by the English corporations and boroughs.

They devote their whole time to the prevention of disease.

Each officer is provided with a fully equipped laboratory and, in addition to his duties in relation to practical sani-

tation, acts as Chemical Analyst and Bacteriologist to his Division or Area.

In addition to these specialist appointments the School of Army Sanitation has been inaugurated under the command of Lieutenant-Colonel R. Firth, late Professor of Hygiene at Netley and at the Royal Army Medical College, the author of Notter and Firth's *Theory and Practice of Hygiene*, which is recognised as one of the most authoritative works in the English language on Hygiene in all its branches.

At this school are trained the Sanitary Section of the Royal Army Medical Corps and the Sanitary Squads of Regiments.

The men of the Royal Army Medical Corps who hold the certificate of the School are granted special rates of pay and attached to regimental units for sanitary duties.

The regimental officers and men who attend courses are granted certificates, and from the men trained at the School will be formed the regimental sanitary squads of the Field Army.

Schools of military sanitation have not yet been established in India, but they are under the consideration of the authorities. Meanwhile every effort is being made to instruct officers and men in the principles of sanitation as the most strenuous sanitary effort must fall to the ground without the intelligent co-operation of *individual* non-commissioned officers and men of the fighting branches.

As an example of occasional lack of this co-operation we may quote Colonel Firth's remarks on the disinfection of infected clothing:—"The medical service finding that a certain individual is suffering from an infectious disease applies to the man's unit for his blankets or bedding to be sent up for disinfection. Whether the right articles are sent or not depends absolutely on the sanitary discipline of the unit.

"Too often the articles have been already placed in a company store, and hopelessly mixed up with others of a similar kind, are untraceable as having been used

by a particular individual, or they have been re-issued to some one else.

"All the same, bedding or blankets are sent up for disinfection, but they are not necessarily the infected articles; these are either infecting other articles in the store or are infecting their new possessors. This is no overdrawn picture, but illustrates clearly the futility of isolated effort on the part of any individual or group of individuals to stop the spread of infection."

Instances of this kind are not likely to occur when the knowledge of the principles on which the regulations enforcing disinfection and similar sanitary precautions are based becomes more widely diffused in the service.

So much for peace organization.

When we come to consider the arrangements for sanitation on active service we find them fairly complete at least as far as the Home Army is concerned.

A Sanitary Service will be formed on mobilization for the purpose of placing the surroundings of troops engaged in the war, or expedition, in as good a condition as possible.

This service will be divided into two divisions, *viz* :—

1. The Sanitary Service of the Field Army.
2. The Sanitary Service of the Lines of Communication and Base.

1. *The Field Army.*—The sanitary essentials required in war are—

1. Pure water.
2. Efficient means of sewage and refuse disposal.
3. Prompt segregation of the sick.

The Sanitary Service of the Field Army to provide these essentials will consist of—

(*a*) Regimental medical officers whose duty it will be to advise commanding officers on all points with reference to the health of the unit.

They will be *primarily* regimental medical officers of health, and *secondarily* executive military surgeons rendering medical aid in all the exigencies of war.

They should, and will, consider it just as important that their regiment or their batteries were the healthiest in the brigade or division as that they themselves were always to be found attending to the wounded regardless of personal risk.

(*b*) Regimental sanitary squads consisting of one non-commissioned officer and eight men per cavalry or infantry regiment, one non-commissioned officer and 6 men per brigade of artillery, and two men for other units such as Field Companies or Brigade Transport Columns (*vide* War Establishments 1908-1909, pages 31, 37, 67 and 82).

These men will act under the regimental medical officer and be responsible for the proper disposal of refuse and excreta.

They will also act as Sanitary Police.

(*c*) A detachment consisting of one non-commissioned officer and 2 men per cavalry regiment or artillery brigade, one non-commissioned officer and 4 men per infantry battation and 2 men for other units.

These non-commissioned officers and men will be selected from men specially trained in water purification and will be responsible, under the medical officer, for providing the unit with a supply of *safe* water. They will have charge of all special apparatus for filtering or boiling and also chemicals for the sterilization of water.

This personnel will remain with units and perform their special duties wherever they may be stationed.

The work of supervising these regimental sanitary arrangements will fall to the following special sanitary officers :—

1. The Assistant Director, Army Medical Service (Sanitary), attached to Head-quarters of the Army.
2. The Sanitary Officers with the Head-quarters of the Cavalry Divisions.
3. The Sanitary Officers with the Head-quarters of the Infantry Divisions.

2. *The Sanitary Service of the Base and Lines of Communication.*—The sanitary arrangements for the base and lines of communication must necessarily be more elaborate than that at the front.

In Army Order No. 3 of 1908, it is provided that on mobilization being ordered a Sanitary Inspection Committee will be formed for service in the field composed as under :—

President.

A Senior Combatant Officer.

Members.

A Field Officer, Royal Engineers.

A Field Officer, Royal Army Medical Corps.

In a general sense this committee will perform duties similar to those of the Local Government Board of the United Kingdom in relation to sanitary inspection.

The committee will act under the orders of the General Officer Commanding-in-Chief.

The duties of the committee will be—

1. To ascertain that sanitary appliances of all kinds required for the army are forthcoming and that an adequate reserve is maintained.

2. To assist general officers and the medical service in their efforts to maintain the health of the army by co-operating not only the work of the different military branches but also the military and the civil sanitary organizations of the country or area occupied.

3. To initiate schemes of general sanitation and to serve as a board of reference for the solution of sanitary questions.

4. To visit and inspect stations occupied by troops, to advise local authorities regarding necessary sanitary measures and to further in every way the maintenance of satisfactory sanitary conditions.

They will report to head-quarters any measure they consider necessary, but which they cannot arrange for locally.

In addition to this committee the Field Service Manual, Army Medical Service 1908, provides for a Deputy Assistant Director, Medical Service (Sanitary), attached to head-quarters of the lines of communication who will control and supervise the sanitary field units.

Two new units of the Royal Army Medical Corps will come into existence on mobilization for duty at the base and lines of communication, *viz.*, Sanitary Sections and Sanitary Squads.

A sanitary section consists of one officer and 25 non-commissioned officers and men of the Sanitary Section of the Royal Army Medical Corps.

One of these sections will be allotted to each base and each rail head.

A sanitary squad consists of a sergeant and five men of the Royal Army Medical Corps (Sanitary Section).

One of these squads will be required for each road or railway post on the lines of communication and two squads for each advanced depôt.

Sanitary squads may be attached to sanitary sections as required.

Their mobilization will be carried out by officers commanding sanitary sections.

The officers commanding sanitary field units will be specialists in public health and with the assistance of the men under their command, who will be invested with the powers of sanitary police they will be responsible for the following duties :—

1. All skilled executive sanitary work such as water purification and disinfection.

2. The supervision of fatigue parties, or hired labor, employed for conservancy purposes.

3. Sanitary supervision of water supply, conservancy, &c., of the Railway station of post and its vicinity if under military control.

4. Constant supervision of water and food supplies, sewage and refuse disposal, and all matters incidental to the duties of a Medical Officer of Health in civil life and his sanitary inspectors.

5. The executive and disciplinary duties of sanitary police.

The scheme of sanitary assistance together with the medical arrangement for the army, is shown in Appendix 3 of the Field Service Manual, Army Medical Service.

In the attached diagram the sanitary organization of an army in the field from front to base in shown in a graphic manner. The diagram is adapted from the diagram issued with the Field Service Manual, 1908.

It is most necessary that it should be clearly understood by officers even for examination purposes as Chapter VI of the Official Manual is entirely devoted to the subject.

So much for the present sanitary organization of our army in peace and war. It is fairly complete but it may be asked what it has actually accomplished for the service.

Sir Alfred Keogh, the present Director-General of the Army Medical Service, has answered this question in a paper on "The Results of Sanitation in the efficiency of Armies in Peace and War," published in the *Journal of the Royal Sanitary Institute* for February, 1909.

As instances where sanitary measures have increased military efficiency he takes four specific diseases in four different quarters of the globe, *viz*:—

1. Tubercular Disease at Home.
2. Cholera in India.
3. Enteric Fever in India.
4. Mediterranean Fever in Malta.

With regard to the first disease Sir Alfred shows that the death rate of the civil population of the military age has fallen since 1860 by 50 per cent. whilst that of the army has fallen 90 per cent.

The difference in the amount of decrease between the civil population and the army may be fairly credited to changes in the soldier's life and surroundings during the period.

2. With reference to cholera in India it is pointed out that in 1861 there were 1,500 admissions and 1,000 deaths from the disease. Now cholera hardly accounts for a single admission per 1,000 per annum.

DISTRIBUTION OF SANITARY SERVICE
IN THEATRE OF WAR.

Cavalry Division.

Sanitary Officer, with H. Q. Division.

□

Regimental Sanitary Squads, and R.A.M.C. attached 3 per regiment for water duties.

INFANTRY DIVISIONS.

□ □ □ □ □ □

Sanitary Officer, with H. Q. Divisions.

□

Regimental Sanitary Squads, and R.A.M.C. attached 5 per Battalion.

ARMY TROOPS.

Asst. Director A.M.S. (Sanitary), with Army Headquarters.

○

HEAD QUARTERS OF THE ARMY.

Regimental or Company Sanitary Squads, and R.A.M.C. for water duties, strength per Regiment as above and at rate of 2 per Company for R.E. and similar units.

MOUNTED BRIGADE.

□ □

Advanced Depot.

Regimental or Company Sanitary Squads and R. A. M. C. for water duties. Strength per unit as above.

Advanced Depot.

2 Sanitary Squads.

ROAD POST.

1 Sanitary Squad.

ROAD POST.

1 Sanitary Squad.

THE ORGANIZATION OF BOTH LINES BEYOND RAIL HEAD IS IDENTICAL.

10 MILES

ROAD POST.

10 MILES

ROAD POST.

10 MILES

RAIL HEAD POST.

1 Sanitary Section.
1 Laboratory.

Deputy Assistant Director A.M.S. (Sanitary) attached to H. Q. L. of C.

25 MILES

Railway Post.

1 Sanitary Squad.

25 MILES

Railway Post.

1 Sanitary Squad.

25 MILES

Railway Post.

1 Sanitary Squad.

22 MILES

1 Sanitary Section.
1 Laboratory.

BASE

Standing Sanitary Inspection Committee.

President.. A Combatant Officer.

Members { Field Officer, R A M.C.
Field Officer, R.E.

"Sporadic cases still no doubt occur and living as the army has to do, an oasis of cleanliness in a desert of filth, it cannot hope to escape such occasional blows; but anything in the nature of the catastrophes of the '80's or the periodical visitations of the '70's and '80's is now out all all practical calculation and that this is so is due to the recognition of the hygienic principle that water is the vehicle of the cause of cholera and to the application of that principle to the exigencies of the soldier's life."

3. With regardence to enteric fever the Director-General points out that here a pure water supply was not a complete safeguard and that owing to defective conservancy and the agency of the fly we were, as yet, unable to show any such creditable reduction in the disease as in the case of cholera.

He pointed out that the incidence of the disease can however be reduced 60 per cent. by inoculation and expressed a hope that in the light of recent discoveries we may before long be able to look on enteric fever as merely an occasional visitor and not as a persistent and unwelcome guest.

4. The learned writer's last illustration was that of Mediterranean fever.

In 1904 there were 320 cases and in 1908 only two!

This change dates from the discovery that the source of the germ of Malta Fever is goat's milk.

"The whole history of sanitation in our army shows no climax so striking, no other preventive measure so surely based on experimental observation and so supremely successful when put into execution."

He then proceeded to show by charts the steadily diminishing loss by death and invaliding in our army since 1860 and drew the natural conclusion that "there is only one explanation possible of this continuous decrease in the loss to the army by death and invaliding ..... and that explanation is improved health, the result of improved sanitation."

Turning to the question of the results of sanitation in war Sir Alfred Keogh gave three examples to show its influence.

He contrasted first the Ashanti wars of 1854 and 1873.

In the former campaign the whole force melted away.

All the men that did not die were invalided.

The death rate of the 1873 campaign, where sanitary precautions were carefully thought out, was only 1·7.

He then showed the difference between the condition of the army in the Crimea before and after the introduction of sanitary measures.

In January 1855 the rate of mortality of the troops was higher than that of London during the great plague of 1665.

During the 22 weeks ending 31st May 1856 the mortality of the army before Sebastopol was only two-thirds of that of the troops at home during the same period.

Sir Alfred's third example of the results of sanitation on military efficiency is very striking as it is shows that even in the dark days of sanitation much could be done to maintain efficiency by attending to even those elementary principles of sanitation which were known in the 18th century.

This chapter and the practical portion of this book may well be concluded by quoting in the distinguished writer's own words his account of this conspicuous instance where the very highest military efficiency went hand in hand with the very highest degree of health.

"The 7th Dragoon Guards, then known as the Black Horse, served in Flanders in the years 1742 to 1747. During this period it is related of this regiment that it never lost a man by desertion, never had an officer or man tried by general court-martial, never had a horse or man taken by the enemy, that it lost but six men by sickness, and had no fewer than 37 of its non-commissioned officers and men promoted to commissions for distinguished conduct.

The efficiency of this regiment and the health of its men were attributed unanimously by all who were in a position to judge, to the attention to the interior economy and welfare of the corps (that is to sanitation) paid by its Colonel,

Sir John Ligonier. This officer had the highest reputation as a fighting soldier, and also as a strategist. The battles of Malplaquet, Dettingen and Fontenoy, in all of which he distinguished himself by personal gallantry, bear testimony to the former quality, while the latest historian of the Seven Years War awards him the highest praise in the latter capacity. It is related of him that such was his anxiety for the welfare of his men that he maintained an additional medical officer in his regiment at his own cost. I have quoted this instance of Sir John Ligonier because one so often hears it said that attending to the health of the soldier is mollycoddling him. The battles of Dettingen and Fontenoy were no child's play; and Sir John Ligonier was no featherbed soldier, while the discipline demanded of the British soldier in the middle of the eighteenth century was as far removed from mollycoddling as any condition of life could well be.

Yet in this regiment, which distinguished itself above all others in that campaign in Flanders, under a commanding officer of whom Marshal Saxe said, "By one glorious action he has disconcerted all my projects," surrounded by other regiments suffering severely from the usual diseases of campaigns in those days, scurvy, fevers and dysentery, only six men died of disease in five years. I think that this incident of military history is as brilliant an illustration as can be given of the connection of sanitation with efficiency in war."

CHAPTER XII.

Examination Questions on the Official Manual of Sanitation.

Syllabus of Examination of Officers for Promotion, King's Regulations, Appendix XI (p. 377).

(J) SANITATION.

All Lieutenants (except Royal Army Medical Officer and Army Veterinary Corps) before promotion to Captain.

One paper based on the Manual of Sanitation in its application to Military Life.

NOTE.—The numbers after each question refer to the sections of the official manual and the pages of the book in which the answers will be found. Number of sections of the manual are printed in thick black type and references to pages in italics.

1. What do you understand by the term Military Sanitation ? Discuss its importance in military life (**1-5** *1-4*)
2. What diseases are most common in armies in the field ? Support your statement by references to important campaigns ? (**6** *7*)
3. What do understand by communicable disease ? (**7** *8*)
4. What factors favourable to the origin and spread of disease are always present in armies in the field? (*6*)
5. On what lines would you attempt to prevent sickness amongst the troops under your command in barracks ? (**11** *6*)
6. In addition to peace measures what further sanitary precautions are desirable with troops in the field ? (**11** chapters *2* and *9*)
7. What do you understand by preventive inoculation ? (**12** *12*).
8. Why is vaccination compulsory in our army ? (*11*)
9. Distinguish between the predisposing and exciting causes of disease. (**14** *7*)
10. Write a note on the relations of germs to disease. (**15** *5*)

11. Give some account of the life history of the different types of microbes. (**16** *5*)
12. How do mosquitoes act in the propagation of disease? (**22** *9*)
13. Are all varieties of mosquitoes dangerous? (**22** *10*)
14. What steps would you take to reduce the number of mosquitoes in barracks under your command? (**23** *10*)
15. Would the same measures prevent the presence of flies, if not, what method of prevention would you adopt to destroy flies? (**24** *101, 77*)
16. What diseases are probably largely disseminated by flies? (**24-25** *16, 18, 7*)
17. What are the causes of enteric fever? (**25** *18*)
18. How long after infection do symptoms of enteric fever appear? (**26** *18*)
19. You are in command of an isolated post, without medical assistance, what would lead you to suspect that an officer or man was suffering from the disease? (**26** *18* and *19*)
20. Give in detail the preventive measures you would adopt against the disease. (**29** *19*)
21. Why is dysentery so important from a military point of view? Support your statements by examples from military history. (**32** *6, 47*)
22. What symptoms would lead you to suspect dysentery? (**34** *16*)
23. What preventive measures against dysentery would you adopt? (**37** *17*)
24. Why is simple diarrhœa a disease of great importance in the field? (**40** *16*)
25. What insanitary conditions are chiefly concerned in the production of epidemics of diarrhœa? (**41** *6*)
26. What orders would you issue to avoid these breaches of sanitary discipline? (**43** *6, 17*)
27. What are the causes and cardinal symptoms of cholera? (**44** *16*)

28. Why is cholera comparatively common amongst the native population whilst it is very rare in cantonments? (**47** *132*)
29. Failing medical advice what procedure would you adopt should a case occur at an outpost under your command? (**48** *17*)
30. What do you understand by malaria? How is it spread? (**49** *16*)
31. Describe an ordinary attack of fever and ague. (*16*)
32. Give in detail the methods you would adopt to protect yourself from malaria. (**54** *10, 17*)
33. What is the military importance of yellow fever? (**56** *20*)
34. What steps would you adopt to prevent it attacking a force under your command? (**59** *21*)
35. What are the causes and characteristics of plague? (**61** *18*)
36. What sanitary measures would you adopt to prevent an outbreak of the disease? (**62** *19*)
37. For what reasons would you prohibit the use of unboiled milk by all soldiers, European or native? (**66** *20, 132*)
38. Do you know of any disease which has been stamped out by attention to the milk supply? If so, give particulars. (**67** *132*)
39. Give some accounts of the disease known as Camp Fever. (**68** *18*)
40. When is this disease likely to appear in epidemic form and what methods would you adopt to check its spread? (**69** *18-19*)
41. What is scurvy? (**71** *59*)
42. Give some account of its military importance. (**71** *59*)
43. Is scurvy communicable from man to man? How may it be avoided? (**72** *59*)
44. Distinguish between the venereal diseases. (**74** *121*)
45. What are the special risks attached to the occurrence of these diseases in barracks and camps? (**75** *121-122*)

46. Discuss their prevention. (**76** *123*)
47. What is consumption ? How is the disease spread ? (**77** *20*)
48. Give the general principles of prevention in relation to consumption. (**77** *21, 30*)
49. Under what headings would you classify the general means of preventing disease ? (**78** *6*)
50. How do germs enter and leave the body ? (**78** *75*)
51. What are the chief agents in the dissemination of the microbes of disease ? (**78** *5*)
52. State the quantity of water required daily for each soldier and the allowance in camps for men and transport animals. (**78** *33*)
53. Give the sources of our water supply. (**81** *34*)
54. What are the dangers of impure water ? (**80** *34*)
55. Generally speaking how would you classify water from deep wells and springs ? (**83-84** *36-38*)
56. Is rain water likely to be safe for use by troops ? (**85** *35, 34*)
57. Discuss the quality of water usually yielded by streams, lakes and rivers. (**86-88** *35*)
58. Show by means of a diagram a good method of protecting a well. (page 37, Fig 2)
59. What are the characteristics of water obtained from shallow wells and ponds ? (**89** *37*)
60. How would you protect the water supply from a spring? Can you suggest a plan for collecting water from such a source ? (**92** *38*)
61. What are the rules regarding the water supply from streams ? (**93** *35*)
62. What are the dangers of "dippers" and what alternative would you suggest ? (**93** *37*)
63. In arranging drinking places for animals and ablution places for men what must be borne in mind? (**94** *109*)
64. How would you protect water from contamination from source to camp ? (**95** *109*)

65. What methods are available for purifying water? (**96** *40*)
66. Give your views on the value of boiling water and the plan you would adopt. (**98** *40*)
67. What orders would you issue with reference to water bottles? (**98** *42*)
68. What varieties of special apparatus have been invented for purifying water without heat? (**99** *41*)
69. Discuss the disadvantages of the usual forms of filter in common use. (**101** *41*)
70. Give some account of the new service water cart (**103-108**)
71. Apart from special apparatus what methods of filtration and clarification may be adopted? (**109** *41*)
72. What chemicals are used for purifying water? (**110** *42*)
73. What are the necessary constituents of the soldier's food? (*44*)
74. What are the dangers of carelessness in food storage? (**113** *14*)
75. Frame some regimental orders to prevent food contamination. (**113** *78-80*)
76. How would you examine tinned foods? (**114** *57*)
77. Give your views on the use of alcohol by soldiers. (**116** *58*)
78. What are the risks attached to mineral waters from unauthorized sources? (**117** *34, 86*)
79. Frame some rules for a regimental ærated water factory. (*78, 86-87*)
80. Give your views on cigarette smoking. (**118** *93*)
81. What are the risks which soldiers run by smoking each others' pipes? (**118** *122*)
82. Write a note on the use of wool as clothing. (**119** *61*)
83. Do you recommend the use of a cholera belt? If not state your reasons. (**121** *68*)
84. What are the relations between boots and military efficiency? (**122** *64, 66*)

85. Give some rules to avoid foot soreness. (**123** *118*)
86. How would you get rid of vermin in clothing? (**124** *96*)
87. Discuss the advantages of fresh air. (**125** *22, 28*)
88. What are the chief constituents of air and their uses ? (**125** *22*)
89. On what principles is ventilation based ? (**126** *23*)
90. What are the chief agents in ventilating barrack-rooms ? (**127** *28*)
91. What cubic space is allowed to soldiers in India and at Home ? (**128** *74*)
92. Give a test of the efficiency of ventilation. (**129** *31*)
93. What notable improvements have resulted from the grant of more air space to soldiers ? (**131** *28, 131*)
94. Give some rules with reference to the care of bedding (**132** *30, 96*)
95. What are the advantages of personal cleanliness in relation to military efficiency ? (**135** *24, 69*)
96. What are the sanitary advantages of the tooth brush ? (**135** *29*)
97. Give some general rules for marches. (**136** *115-117*)
98. What are the commonest causes of men falling out ? (**137** *118*)
99. What measures would you adopt to prevent men falling out ? (**139** *118-119*)
100. What sanitary measures would you enforce at halts on the line of march ? (**140** *117*)
101. What would you consider a good site for a camp ? (**142** *105*)
102. What sites would you avoid and why ? (**142** *105*)
103. How would you prepare the ground for a camp if time was available ? (**143** *105-106*)
104. What special measures would you adopt in malarious districts ? (**143** *105,108*)
105. Write a note on tents. (**144** *106*)
106. How would you provide for surface drainage? (**145** *107*)
107. Frame some rules for the disposal of camp refuse. (**146** *111*)

108. What points require special attention in camp kitchens ? (**149** *110*)
109. Why are horse lines a special source of danger in standing camps ? (**150** *84*)
110. How frequently would you shift camp on purely sanitary grounds ? (**153** *107*)
111. How far should latrines be from the tents ? (**111** *111*)
112. Draw a rough plan of a camp showing proper sites for kitchens, latrines, urinals, and ablution places. (**154** *109-113*)
113. How would you ensure excreta being covered with earth ? Why is this procedure necessary ? (**155** *111, 117*)
114. Draw up some rules for camp conservancy ? (**156** *110-113*)
115. What are the essential sanitary requirements of a standing camp ? (**157** *104*)
116. Why are camps less sanitary than barracks ? (**158** *106*)
117. Draw up a code of orders in relation to the care of latrines and urinals for your regimental sanitary section. (**164** *111-112*)
118. How should refuse be disposed of ? (**167** *113*)
119. Frame a code of rules for your regimental kitchens. (*78-80*)
120. What are the dangers of dust ? (**172** *25*)
121. How should cleaning materials be stored ? (**173** *79*)
122. Under what categories does the scheme of sanitation for field service fall ? (**176** *127*)
123. What are the main sanitary objects of an officer commanding a unit in the field ? (**177** *127*)
124. Describe how the sanitary service will strive to provide the sanitary essentials of success. (**178** *127*)
125. Give the composition and duties of the Sanitary Inspection Committee of a Field Army. (**181** modified by Army Order 3, 1908. *129*)

126. Name the field units of the R. A. M. C. which will be mobilized for duty at the Base and Lines of Communication. Give their composition and duties. (**181** and War Establishments 1908-1909. *130*)

NOTE.—A pass in this course can be reckoned as part qualification towards the medallion of the Association, if taken in lieu of Home Nursing or Home Hygiene.

ST. JOHN AMBULANCE ASSOCIATION.

Syllabus of Instruction: Military Sanitation.

First Lecture.

A. Preliminary Remarks. Objects of Instruction.

B. Water Supplies. Diseases caused by impurity.

C. Quantity required for Health. Sources from which obtained and special qualities.

D. Dangers of Pollution connected with each source of supply.

Second Lecture.

A. Purification of Water. Physical, Mechanical, Chemical.

B. Difficulties connected with each method. Time, expense, apparatus, transport.

C. Filtration uses and defects. Improvised methods illustrated.

D. Water Carts. Old pattern and new. Description of present Army System.

Third Lecture.

A. Conservancy in Barracks and Habitations. Latrines, Urinals.

B. Kitchens and Refuse receptacles. Ablution Rooms, Living and Recreation Rooms.

C. Camps. Special difficulties connected with Conservancy. Tents, Improvised Destructors, Surface drainage.

Fourth Lecture.

A. Infection and Infectious Diseases. Explanation and Description.

B. Means of propagation and methods of arrest and treatment.

C. Disinfection of persons, clothing, and dwellings. Disinfectants described.

D. Ventilation, necessity. Results of neglect. Methods in use and ordinary apparatus.

Fifth Lecture.

A. Exercise, Marching, Thirst.

B. Suitable clothing and care of feet.

C. Food, with special reference to Cooking and special rations.

D. Scurvy, past and present, Alcohol, use and abuse, Sunstroke and Heatstroke, Venereal Diseases.

INDEX.

BOOKS ON MILITARY SANITATION, HYGIENE, &c.

	Rs.	a
Army Tables, Medical, India, 1905	0	8
McNamara (Brigade-Surgeon Lt.-Col. W. H.).—Notes on Medical Services in War, 1895	0	14
Standing Orders for the Royal Army Medical Corps and Queen Alexandra's Imperial Military Nursing Service. War Office, November, 1903	0	14
Manual for the Royal Army Medical Corps. War Office, 1908	0	11
Regulations for the Army Medical Service, 1906	0	7
Howard (Lt.-Col. F.)—Handbook of the Medical Organisations of Foreign Armies, 1902	0	14
Edye (Major J. S.).—A Guide to Medical Officers on Field Service, 1904..	0	14
Yarr (M. T.)—Manual of Military Ophthalmology for the use of Medical Officers of the Home, Indian, and Colonial Services, 1902	4	8
Lewes (Dr. P.).—A Manual of Medical Exercises, 1897	0	14
Beggs (Capt. S. T.).—Guide to Promotion for Officers and Men of the R. A. M. Corps	3	1
Webb (Surgeon Wm. W.).—The Indian Medical Service. A Guide for Intending Candidates for Commissions, and for the Junior Officers of the Service, 1890	4	0
Extract from the Manual for the Royal Army Medical Corps. Section II. Royal Army Medical Corps Drills and Exercises. War Office, 1899	0	4
Marshall (Major J. J. de Zouche).—Stretcher Drill. Illustrated. Second Edition, including the new Hand-seat, Wagon and Railway Wagon Drills, 1904	2	10
Munson's The Theory and Practice of Military Hygiene, 1904 ...	28	0
Manual of Sanitation in its application to Military Life, 1907 ...	0	3
Heath's Examinations in Military Sanitation, 1908....	1	5
French's Syphilis in the Army, 1907	5	4
Firth's Military Hygiene. A Manual of Sanitation for Soldiers, 1908	3	1
Army Regulations, India, Vol. VI (Medical), 1906	0	10
Caldwell's Military Hygiene, 1905	9	3
Hughes' Manual of Chiropody	0	3
St. John Ambulance Association's First Aids to the Injured	0	14

THACKER & Co., Limited, BOMBAY.

PRINTED AT THE BRITISH INDIA PRESS,
FORT, BOMBAY.